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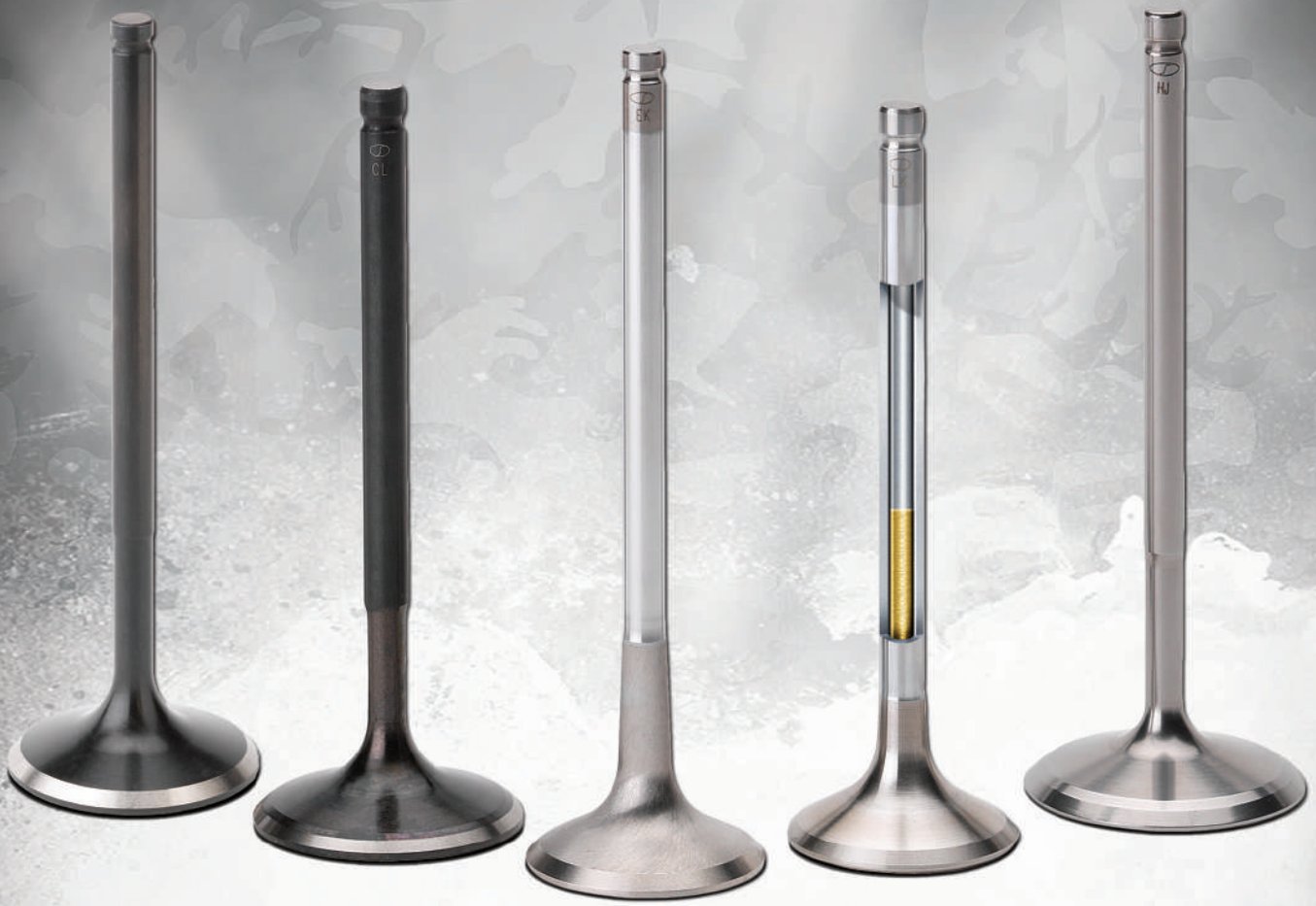

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THE MAVERICK WHO STILL MATTERS

IN MOTORSPORT, innovation is too often defined in terms purely of hardware: the most advanced aero package, the lightest materials, the cleverest ERS deployment. But real innovation – game-changing, trajectory-altering innovation – often begins with a mindset.

Few individuals in Formula 1's storied history have embodied that can-do mentality quite like Eddie Jordan.

Some people – my Publishing Director included – will question my devoting an entire feature to 'EJ'. But this is the first time we've returned to the British Grand Prix at Silverstone – Eddie's spiritual heartland – since we lost him, so please forgive my indulgence. It's not our normal fare, but it *is* an excellent tale!

EJ's unapologetically human approach – flawed, funny, fiercely passionate – made him both loved and loathed at different times. He wasn't afraid to ruffle feathers, to take risks.

He brought rock-and-roll, commercial creativity, disruption, but Jordan's greatest gift to the sport arguably wasn't the cars – it was the drivers. He knew that the big teams would often spend fortunes on the technology, but they wouldn't spend time on their drivers. They forgot that only two things connected that technology to the racetrack: the tyres and the hero behind the steering wheel.

Jordan Grand Prix didn't just thrive in the shadow of giants; it did so in spite of them. In part that's because he didn't just follow data; he followed instinct. He was capable of seeing not just the driver in front of him, but the champion they might become.

Inevitably, he is remembered as the man who gave Michael Schumacher his F1 break. "Did I make Schuey? No, Schuey made Schuey," EJ once told me. "But at that point his career was at a crossroads and he needed to be given a chance."

Jordan also handed Ayrton Senna his first test in Formula 3 – the Brazilian was three-tenths of a second quicker than the pole time set at the same circuit the previous week! - and took a chance on the likes of Johnny Herbert, Jean Alesi, Martin Brundle, Rubens Barrichello, Eddie Irvine, Martin Donnelly, Ralf Schumacher and Giancarlo Fisichella.

"I wouldn't want it to say 'talent scout' on my epitaph," EJ said in our last conversation. "Sounds a bit Hicksville, doesn't it! People will say it's the blarney, but I do believe I could look a young driver in the eyes and make him believe in himself."

Formula 1 is in a period of extraordinary technical innovation right now — cell chemistry, advanced hybrid powertrains, moveable aerodynamics, sustainable fuels, AI-assisted design — but the sport would do well not to forget the kind of creative disruption that Eddie Jordan brought to the paddock.

Jordan's story is a reminder that the sharpest tool in any engineer's box might just be the willingness to challenge convention. RT

Mark Skewis
EDITOR

Hydrogen revolution gathers pace

Mark Skewis reports on major milestones along the path to the adoption of hydrogen in endurance racing

THE dimensions of Toyota's new GR LH2 Racing Concept – 5,100 mm long and 2,050 mm wide – might not strike you as special, but the size of the car's impact on the way we go motor racing could be immense.

It has been seven years since the Automobile Club de l'Ouest, organiser of the Le Mans 24 Hours, first unveiled its hydrogen strategy. Since then, the technology's race debut has been pushed ever backwards. Now Toyota won't even set a timeline for when its liquid hydrogen-fuelled prototype will run. Yet was its launch the moment when the prospect of hydrogen-propelled racecars competing in the endurance classic finally became real?

The ACO is the first to admit that it lacks the resources of a manufacturer. That's why it has just struck a deal with Toyota GAZOO Racing to collaborate on the aerodynamics and cooling of its forthcoming hydrogen fuel cell-powered H24EVO (see sidebar).

Toyota's GR LH2 Racing Concept, meanwhile, investigates the hydrogen conundrum by coming at it from the other direction: combustion rather than fuel cell. The car will advance not only Toyota's own understanding of running an internal combustion engine fuelled by liquid hydrogen, but it will also further the entire industry's knowledge of the infrastructure and refuelling know-how necessary to implement this technology.

The GR LH2 has been built in Cologne around a chassis from the current GR010 HYBRID Le Mans Hypercar, compared to which it is only 200 mm longer and 50 mm wider.

TGRE chairman Kazuki Nakajima said: "Our intent at this moment is to test the car, test not only the combustion engine but to learn a lot about the infrastructure and fuelling system.

"Our main target right now is to expand the possibilities of hydrogen combustion engine technology.

"There is more to come and to get to the right level we need to improve the technology further."

Photos: Toyota GAZOO Racing

BELOW The GR LH2 Racing Concept was exhibited at the ACO's H2 Village

Real progress

No details of the engine or hybrid system, which have been developed at Toyota's Higashi-Fuji Technical Centre in Japan, were revealed.

What we *do* know is that the manufacturer is making remarkable progress with the technology in Japan, where it has been trialled on an experimental Corolla in the Super Taikyu series.

Ahead of this year's Fuji 24 Hours, the blue ribband event of the championship, TGR focused its efforts on three particular challenges: balancing the quest for performance with efficiency; improving a hitherto troublesome refuelling system; and reducing vehicle weight.

It is experimenting with the engine automatically switching between stoichiometric combustion – the ideal air-to-fuel ratio during combustion – which delivers high output, and lean combustion, which enables fuel-efficient driving, in response to the driver's output requirements (accelerator operation).

Until now, Toyota has continued to chase improved stoichiometric combustion to achieve high output equivalent to that of gasoline. From Fuji onwards, the system is intended to smoothly switch to lean combustion when high output is not required with a view to applying it to the development of future production vehicles.

Crucial changes have also been made to the refuelling infrastructure. A new internal piston structure for the car's filling valve has been adopted – eliminating the need for an external actuator, saving weight and reducing the risk of leakage, while also improving filling speed by 30 per cent.

The engineers' increasing familiarity with liquid hydrogen technology has also enabled them to reduce the overall weight of the vehicle. Where hydrogen's corrosive qualities had forced them to use copper wiring, the latest iteration of the Corolla features partial use of aluminium wiring thanks to the use of fibre laser welding technology developed by Furukawa Electric Co Ltd. This change has also resulted in an 18% weight reduction over the previous wire harnesses.

LEFT Toyota's experiments with liquid hydrogen in Super Taikyu make it a leader in the technology

Developed with input from industry experts across sectors such as aerospace, energy, hydrogen infrastructure, automotive hydrogen storage, refuelling technologies, system integration, risk assessment and safety engineering, as well as automotive manufacturers and the ACO, the new framework, soon to be integrated into Appendix J, Article 253 of the FIA's International Sporting Code, sets strict standards for vehicle integration, storage systems, and refuelling procedures. Key safety measures include pressure-tested compartments, multi-alert hydrogen leak detection and boil-off limits.

Best Fuji 24 Hours yet

The raft of improvements resulted in the Corolla H2 Concept enjoying its strongest run yet in this year's Fuji 24 Hours. It completed a total of 468 laps (approximately 2,135 kilometres) across a race that lasted for 23 hours after fog caused the start to be delayed by an hour, and which was also neutralized by two red-flag periods totalling almost three-and-a-half hours due to thunderstorms.

That meant the car fell just short of its previous record of 478 laps, set in 2022 when still running on gaseous hydrogen, before the switch to liquid hydrogen in 2023.

However, in terms of the percentage of the winning car's laps completed, this was by far the Corolla H2's most impressive showing, as it completed 83.6 per cent of the winning car's laps, as opposed to 62.9 per cent in 2022.

The team's improvements to the hydrogen refuelling were also deemed a success. By lowering the temperature and taking time to fill the tank, they were able to store more liquid hydrogen with a method they called "slow refuelling".

After the race, in a pit filled with smiles and tears, Akio Toyoda, Chairman of the Board of Directors at Toyota Motor Corporation, said: "It was a long journey. But I feel like this year we finally truly joined the race... I think we've made real progress."

Major milestone

If the launch of Toyota's GR LH2 Racing Concept marked a major step along the road to the adoption of hydrogen, then the impact of the learnings from its pioneering tussle with liquid hydrogen in the Super Taikyu series should not be underestimated.

The FIA laid down another milestone last month when its World Motor Sport Council approved the Federation's first-ever set of safety regulations for vehicles powered by liquid hydrogen.

Toyota alliance to drive MissionH24 forward

A NEW collaboration with Toyota GAZOO Racing has been announced to accelerate the ACO's experiments with its hydrogen-electric prototypes.

The strategic partnership will see the Japanese manufacturer share its expertise in hydrogen technology and motorsport, with a particular focus on areas like aerodynamics and cooling. MissionH24's new H24EVO, powered by a hydrogen fuel cell, signals a change in the pace of the programme's agenda, by chasing outright performance for the first time, and Toyota's knowledge in these areas could be a real game-changer.

Pierre Fillon, President of the ACO and Co-President of MissionH24, said: "This collaboration is a major new step. Toyota GAZOO Racing has been involved for several years in the deployment of hydrogen in competitions in order to decarbonize racing and more global mobility, as well as industry. Toyota is leading a real fight against CO2.

"Being able to rely on such a partner ensures an unwavering commitment to achieving our objective: to offer a technological laboratory demonstrating to all the potential of hydrogen to succeed in the energy transition."

Bassel Aslan, Technical Director of MissionH24, commented: "Toyota declared war against CO2 at a very early stage with hybrid automotive solutions for mass production. Who can forget the Prius? By joining MissionH24, Toyota joins another motorsport decarbonization battle.

"Finding the right trade-off between an efficient cooling system and performant aerodynamic behaviour will be the challenge that we trust to overcome thanks to Toyota support."

RIGHT TGR's involvement could take the fuel cell project to the next level

Ferrari hits back after Le Mans disqualification

FERRARI hit back over the disqualification of its #50 499P Hypercar from fourth position at the Le Mans 24 Hours – a ruling that tarnished some of the shine reflecting from its hat-trick of victories at the endurance classic.

The Italian manufacturer pointedly expressed its "surprise" at the decision, even though the car's rear wing – from which four bolts were missing – exceeded the maximum permitted deflection by about three and a half times the limit when tested. Instead, it contended that the car gained no performance advantage, nor posed any safety threat on circuit.

The car – piloted by former Le Mans winners Antonio Fuoco, Nicklas Nielsen and Miguel Molina – was a contender for victory throughout the race, but the overnight safety car intervention dealt a blow to its prospects. It ultimately took the flag fourth, just over a second shy of the sister #51 Ferrari, which claimed the final podium position.

The case against Ferrari

However, post-race scrutineering determined that the car's rear wing support was 'not in compliance with the deflection test indicated in Article 3.8.7 of the 2025 LMH Technical Regulations and the homologation form for Car #50'.

The stewards' decision highlighted that four bolts were found to be missing from the rear wing support, as per the car's homologation form. A rear wing deflection of 52 mm was recorded during the post-race test, breaching the maximum permissible deflection of 15 mm.

It was further explained that during the last pit-stop at 15:23, a mechanic noticed the absence of only one bolt on the rear wing support, but no corrective action was taken before the end of the race. The competitor explained this decision was made after reviewing the car telemetry, which allegedly showed no change to the car's speed.

However, the Stewards noted that car 50 achieved its highest top speed on lap 380 out of 387.

Moreover, the scrutineers considered the rear wing assembly non-compliance to have presented a potential safety risk. They contended that the irregular and incomplete assembly of the rear wing support presented a risk of structural failure under high-speed stress or fatigue.

The #50 car was duly disqualified from the final race results, elevating the pole-sitting #12 Cadillac Hertz Team JOTA V-Series.R to fourth and the #7 TOYOTA GAZOO Racing GR010 Hybrid to fifth. The stewards' decision did not affect the other two Ferrari Hypercars, which finished first (#83) and third (#51).

The defence

Ferrari argued that, given the design of the element, the absence of one or more of the bolts did not compromise the car's safety in any way. It said the subsequent loss of the remaining bolts during the final 37 minutes of the race provided no advantage in terms of performance or the final standings.

It explained that the top speed of the #50 499P reported by the Stewards in their decision was recorded during the car's final seven laps while it was running in the slipstream of its sister car, the number 51 499P.

Ferrari's statement said: "While surprised by the decision, Ferrari reaffirms its complete confidence in the professionalism and integrity of its team, in the actions taken, and in its respect for the regulations governing the FIA World Endurance Championship."

It said that it retained "full confidence" in the regulations, "even though the incident in question offered no competitive advantage to the crew, nor did it compromise the safety of our drivers or that of other competitors."

Following the disqualification, Ferrari retained its lead in the championship's Manufacturers' and Drivers' standings. RT

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BELOW Ferrari denied that flexing of the rear wing offered a performance advantage

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RIGHT & BELOW McLaren showed its Hypercar; Ford revealed that Dan Sayers will oversee its powertrain project

Pieces of WEC puzzle fall into place as Hypercar extension confirmed

THE homologation cycle of the FIA World Endurance Championship's top-tier Hypercar class will be extended until the end of 2032.

The news was confirmed at Le Mans last month among a blizzard of announcements. They included updates on the forthcoming Ford, McLaren and Genesis Hypercar programmes, as well as the unveiling of the winners of the next-gen LMP2 tenders.

Originally set to conclude in 2029, the extended homologation cycle ensures long-term stability for the Hypercar class, a technical platform that has enjoyed significant success since its debut in 2021.

Since its launch, 12 different manufacturers have participated in the class, building cars to either LMH (seven) or LMDh (five) regulations.

With more automotive brands preparing to enter the class in 2026 and 2027, the extension allows them to avoid developing entirely new cars for a brief homologation cycle.

The second wave of Hypercar entrants – entering through the LMDh route – all divulged further details of their projects in the build up to the Le Mans 24 Hours. McLaren confirmed its collaboration with United Autosports, use of a twin-turbo V6 engine and chassis developed and built by Dallara.

James Barclay, currently managing director of JLR Motorsport and Team Principal of Jaguar TCS Racing, is to join the team in September at the end of the Formula E season. McLaren Racing CEO Zak Brown said of Barclay: "James's leadership will be crucial in guiding us through the coming months as we prepare for our 2027 entry. We have a rich history in the sport, and with James at the helm, we are confident that McLaren Endurance Racing will quickly establish itself as a competitive and successful team."

Genesis also announced several key appointments for its forthcoming programme, which will use an ORECA chassis. The most high-profile of them is new sporting director Gabriele Tarquini. The Italian is one of the most successful touring car drivers of all time, having won the British, European and World Championship titles, as well as the inaugural WTCR FIA World Touring Car Cup in 2018 with Hyundai Motorsport.

Anouck Abadie becomes team manager. The Frenchwoman has previously worked within the FIA and with leading endurance teams in managerial positions, most recently with GT squad Kessel Racing.

Justin Taylor, who has worked as a race engineer in both WEC and IMSA, becomes chief engineer.

Blue Oval

Ford also revealed two key building blocks of its factory Hypercar programme as it continues to ramp up preparations ahead of its return to top-tier prototype competition, some six decades on from its run of four consecutive triumphs at Le Mans from 1966 to 1969 with the iconic GT40.

The Dearborn-based manufacturer will rejoin the battle for overall glory with the support of chassis supplier ORECA.

"We are coming back to Le Mans to win, and we aren't making a secret of that," commented Ford Motor Company President and CEO, Jim Farley.

Dan Sayers has been handpicked to join the Ford Hypercar project as Programme Manager, transitioning across from his current position as Programme Director at Red Bull Ford Powertrains, where he played an instrumental role in the company's power unit programme for Formula 1's forthcoming 2026 regulations.

Prior to that, the Briton spent 10 years at Prodrive, working on the design and development of Aston Martin Racing's GT cars.

"Ford Performance is taking on so many different challenges around the racing world, but to lead Ford back to its spiritual home of Le Mans was a challenge I couldn't turn down," explained Sayers.

"Having previously led Aston Martin to multiple Le Mans class victories, the opportunity to take overall honours with Ford is something very special. I have loved working on the F1 programme with Red Bull Ford Powertrains, so this feels a lot like joining a different part of the same family."

"The chassis partner and the programme lead for any major factory programme are foundational elements," added Mark Rushbrook, Global Director of Ford Performance. "ORECA and Dan Sayers give us the right platform to build this entire programme."

The results of the FIA-launched tender for the chassis and engine suppliers of the next generation LMP2 class, arriving in 2028, have also been revealed.

LMP2 will continue to be powered exclusively by Gibson Technology engines, now turbocharged to improve efficiency, while maintaining a single engine supplier to help keep costs under control.

The chassis, featuring safety upgrades, including a new central driving position, will come from one of the two approved constructors, ORECA or Ligier Automotive, providing the class with diversity in terms of aesthetics of the cars.

LMP2 continues to be a vital category in endurance racing, with full-season competition across the European Le Mans Series, Asian Le Mans Series and IMSA SportsCar Championship, as well as its traditional one-off appearance at the 24 Hours of Le Mans. RT

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Digby wins MIA Award for Outstanding Contribution to the Motorsport Industry

PETER DIGBY has been recognised by the Motorsport Industry Association (MIA) for Outstanding Contribution to the Motorsport Industry.

The Chairman of the British Racing Drivers' Club (BRDC), Digby is also a former President of Xtrac and Chairman of the MIA. He was presented with the award at the House of Lords, London, during the MIA's annual Summer Reception.

Digby started his motorsport career in 1979 at Williams Racing, rising to become Production Manager. After a short spell at Haas Lola as Assistant Managing Director, in 1986, former Hewland engineer Mike Endean persuaded him to join the fledgling British transmission manufacturer Xtrac. He went on to establish the company as one of Motorsport Valley's greatest success stories.

Operating from its headquarters in Thatcham, Berkshire, Xtrac established facilities in the United States in Indianapolis, Indiana, and Mooresville, North Carolina and recently, Austria.

Xtrac supplied transmissions to 90% of the Le Mans grid this year. It is also the exclusive transmission supplier to the NTT IndyCar Series, the NASCAR Cup Series, LMDh entries in IMSA, the British Touring Car Championship (BTCC), and the eWRX, the first all-electric off-road FIA World Championship.

As Chairman of the BRDC, Digby led the team which negotiated a new 10-year deal with Formula One Management (FOM), securing the British Grand Prix's future at Silverstone until at least 2034.

He was Chairman of the MIA for five years, from 2003 to 2008.

"Winning the MIA Award for Outstanding Contribution to the Motorsport Industry is a great event for me," said Digby. "I've been involved with the MIA for well over 30 years, I've been Chairman of the Association, and I've seen what it's done for the industry. It's an honour to be recognised by my peers, and I'm really excited by it!

"This was a total surprise. Being recognised in the industry that I love, and have worked in now for over 45 years, is just a great honour."

Chris Aylett (Chief Executive Officer, MIA) said: "Peter deserves all the praise he gets for winning this MIA Award, voted on by our members. His well-informed knowledge, huge experience and determination to bring success to Xtrac never wavered. So many, working in motorsport today, have benefited from his advice, occasional criticism, and support!"

ABOVE Chris Aylett and Peter Digby with Lord Astor of Hever

Monolith becomes AI development partner for PREMA

PREMA Racing has inked a deal with artificial intelligence (AI) software provider Monolith, which will become its AI development partner.

Monolith's highly advanced machine learning platform will deliver bespoke models for PREMA's engineering department in the NTT IndyCar Series. In addition, the partnership will extend to single-seater competition, as it will also be sponsoring the organisation's FIA Formula 2 Championship and FIA Formula 3 Championship outfits.

Monolith's proprietary AI technology will produce bespoke models that will allow the team to unlock on-track performance through smart racecar setup optimisation, implementing customised aerodynamic maps, virtual sensors, and trackside anomaly detection to validate incoming data from the track in real time.

In addition to analysing the variables affecting racecar set-up, from track characteristics and weather situations to driving styles, the ground-breaking solution will also provide cost- and time-efficiency gains.

Guillaume Capietto, Technical Director, PREMA Racing, said: "It's no secret that AI is the new frontier and finding new ways to apply it to enhance performance will be the key to motorsports success in the future. Having Monolith by our side is invaluable. They already have an incredible expertise and know-how. With research and the real-world racing experience and expertise that we can provide, the potential is incredibly high."

ABOVE PREMA is the latest race squad to leverage machine learning

Sam Emeny-Smith, Head of Automotive and Motorsport, Monolith, commented: "Machine learning is a prime solution for helping race teams find meaningful performance gains while reducing the need for physical testing. The NTT IndyCar Series represents a championship where incremental, marginal gains in setup optimisation make all the difference in securing on-track success – gains that Monolith has continually earned for its partners in the world of motorsport."

The new partnership is the latest in a number of top-flight motorsport projects for Monolith, which continues to support the highly successful JOTA Sport outfit in in the competitive Hypercar class of the FIA World Endurance Championship with Cadillac Hertz Team JOTA.

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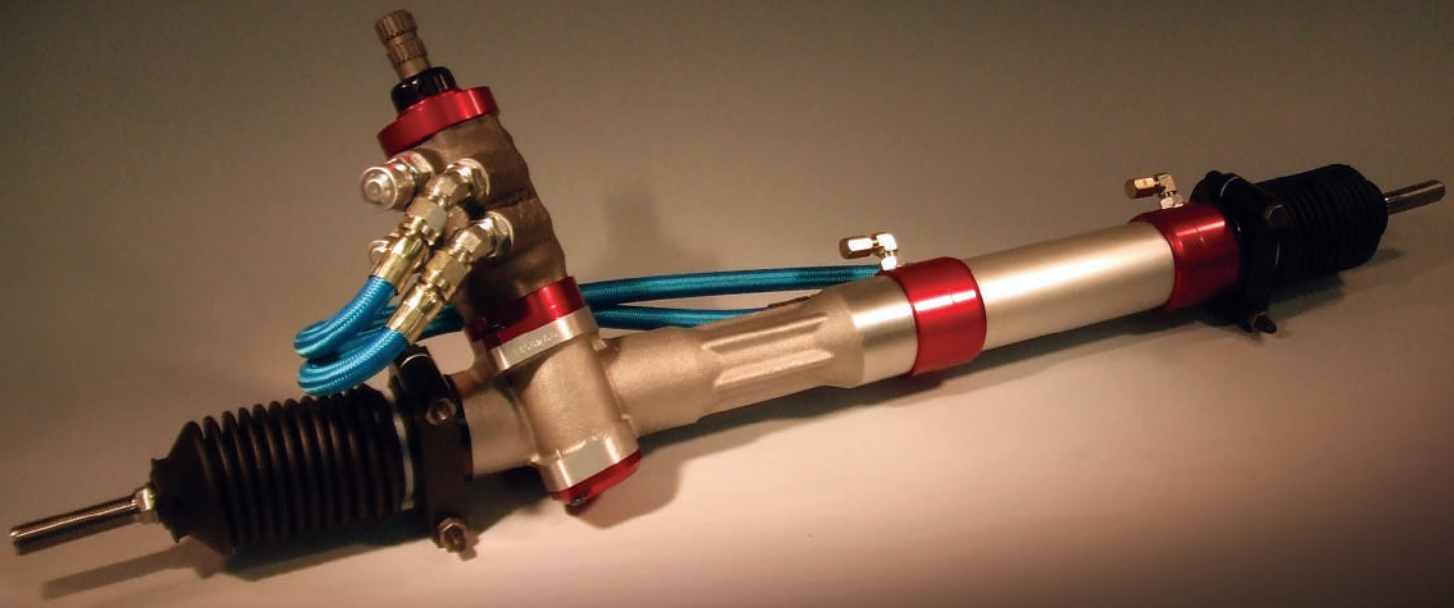

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Goodyear's 55% sustainable material tyre makes truck racing debut

GOODYEAR has introduced a new truck racing tyre, made of 55% sustainable materials.

In what is being hailed as a significant move for motorsport and mobility innovation, the new generation of racing tyres made their competitive debut in the Goodyear FIA European Truck Racing Championship (ETRC).

The 55% sustainable-material content is achieved through the use of carefully selected ingredients, such as silica produced from waste rice husk ash and carbon black sourced from alternative feedstocks.

Goodyear has been a key player in the European Truck Racing Championship series since 2003. It says the series serves as a platform for testing next-generation tyre solutions, with insights gained from the racetrack influencing the development of Goodyear's commercial truck tyres.

ABOVE Goodyear's new tyre could influence the commercial fleets

"With the introduction of Goodyear's next-generation 55% sustainable-material racing tyre, we take another step toward the sustainability transformation of our truck racing series," said Georg Fuchs, Managing Director of ETRA. "This partnership demonstrates that sustainability and performance can go hand in hand, paving the way for a more responsible future in both racing and road transport."

"The Goodyear FIA ETRC serves as an additional proving ground for the latest advancements in truck tyre technology," said Maciej Szymański, Marketing Director, Commercial EMEA, Goodyear. "By increasing the share of sustainable materials in our racing tyres, we not only support the championship's sustainability agenda but also pave the way for broader innovations that benefit the entire transport industry."

The new tyres are the latest landmark on the ETRC's sustainability journey. The championship has been running on 100% renewable HVO biofuel since 2021 and holds the FIA's three-star environmental accreditation – the highest level in the framework. RT

Michelin designs greener Hypercar tyre for 2026

MICHELIN has produced a new range of slick tyres made from 50% sustainable materials that will be used from next year in the World Endurance Championship and IMSA series.

The exclusive supplier to the Hypercar class has designed its Pilot Sport Endurance range with three aims in mind: performance, durability and a more environmentally friendly compound.

With this model, Michelin is taking a significant step forward in endurance tyre development. "Since the inception of the Hypercar class, the competitors have pared a second off lap times by optimising tyre use," said Matthieu Bonardel, Head of the Motorsport Business Line at Michelin. "Given the technical and sporting success, it is tempting to opt for stability. But it's precisely when everything is running smoothly that we need to be bold and go a stage further."

The aim was to produce tyres that were equal to the existing range in terms of one-lap performance, but with improved durability and also enhanced warm-up following the ban on tyre warmers at the start of 2023.

Michelin tested 11 new materials defined as renewable or recycled during development of its 2026 tyres and has ended up retaining seven. It also tried 14 what it called "technical bricks" during development and is using five in the new range.

The new range marks Michelin's first mass-volume tyre produced with such a high level of recycled and renewable materials.

A total of 30,000 units will be produced each year, which contrasts with the low volumes in which tyres with similar levels of sustainables have been made for the MotoE World Cup electric motorcycle series and those used on the Mission H24 hydrogen fuel-cell demonstrators.

The use of new materials and technologies in the WEC tyres is part of Michelin's drive to introduce tyres made from 100% sustainable materials for the road by 2050. RT

LEFT Final trials are taking place before the tyres are introduced for next season

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Ram returns to NASCAR, Dodge to follow?

DODGE'S return to NASCAR's top tier moved a step closer last month when the Stellantis group announced that Ram, a spin-off from Dodge, will run a Craftsman Truck Series campaign in 2026.

Ram will become the first new OEM in NASCAR's national-series ranks since Toyota brought its Tundra model to the track in 2004.

A Ram 1500 concept race truck was unveiled at the launch event where Tim Kuniskis, chief executive of Ram, revealed that the brand has ambitions far beyond NASCAR's feeder series.

"We're looking for a date to the prom right now," Kuniskis said. "So how am I going to get to Cup? That's going to depend on how I get to Truck. So however we get to Truck is going to obviously weigh heavily on 'do I have a path to Cup?' Our intention is not to do a one-hit wonder and go to Truck and not to Cup. That's not our plan."

Dodge Ram celebrated three manufacturer titles in the Craftsman Truck Series (2001, 2003-04) during its first stint in the category, which ended after the 2013 campaign.

"For more than a decade, customers and our dealer network asked about getting back into NASCAR. The desire was always there, but we didn't have a plan that delivered the last tenth and following just didn't fit our DNA," said Kuniskis. "Now we have a solid plan that will set us apart from the field and will bring fresh new interest and engagement to America's motorsport."

Returning to the racetrack marks a major milestone for the brand which is in the midst of a drive that includes 25 product announcements over 18 months. Joining the Truck Series is a natural, strategic move, given that more than 40% of NASCAR fans are truck owners. The popular and competitive race series gives Ram a high-performance showcase as it launches a series of exciting new trucks. Crucially, Ram has also announced that the classic 5.7-litre Hemi V8 will return to its production lineup.

"Ram returning to the NASCAR Craftsman Truck Series is a major moment for the sport, and a sign that NASCAR remains a strong platform for blue chip brand partners," said John Probst, NASCAR executive vice president and chief racing development officer.

Dodge last competed with factory support in NASCAR's Cup Series in 2012. That run concluded with Brad Keselowski claiming the Cup championship for Team Penske that year in a Dodge Charger.

Probst said the runway for any prospective automakers to launch a Cup Series venture would be based on an 18-month timetable to allow for proper engine development and the submission of a competition-ready body. He also indicated that other manufacturers might be willing to follow Ram's lead.

"I don't want to jinx ourselves, but I would say that we are very close with one other," Probst said. "Can't speak for them. Obviously, it's their decision to make. We would love for them to decide to come into NASCAR, and even with that, there's one or two others that we're a little bit earlier in the discussions, but also looking pretty positive. But we all know that an OEM deciding to come into NASCAR, it's a big commitment for them. It's not something that they take lightly. It requires a lot of research and approval at the highest levels. We're confident right now. We like the position we're in, and think that we're a pretty good investment for an OEM."

BELOW Ram intends to have at least four trucks on the NASCAR Craftsman Truck Series grid next year

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NASCAR rebels upbeat in spite of court setback

23XI Racing, the Cup Series team co-owned by Michael Jordan and Denny Hamlin, remains confident of winning its lawsuit against NASCAR – despite a setback in court last month.

23XI and Front Row sued NASCAR late last year after refusing to sign new agreements on charter renewals. They asked for a temporary injunction that would recognize them as chartered teams for this season, but the Fourth Circuit Court of Appeals in Richmond, Virginia, ruled in NASCAR's favour.

Hamlin has confirmed that 23XI remains committed to running as an open team for the remainder of 2025 if it has to, despite the fact that it faces losing tens of millions doing so compared to if it was a chartered team.

The 23XI co-owner also explained that despite the ruling, the team remains upbeat about its chances in the wider lawsuit case.

"We remain very confident in our case," Hamlin said. "We feel like the facts are on our side."

Speaking after the court ruling, Jeffrey Kessler, the attorney representing 23XI and FRM in the lawsuit, explained: "This ruling is based on a very narrow consideration of whether a release of claims in the charter agreements is anti-competitive and does not impact our chances of winning at trial [scheduled for December 1].

"We remain confident in our case and committed to racing for the entirety of this season as we continue our fight to create a fair and just economic system for stock car racing that is free of anti-competitive, monopolistic conduct." RT

Getty Images/NASCAR

BELOW 23XI and FRM risk losing their charters

All ICE teams to race sustainable fuel at Formula Student

ALL petrol vehicles taking part in this year's Formula Student competition will use SUSTAIN biofuels, thanks to a partnership between the Institution of Mechanical Engineers (IMechE) and fuel supplier Coryton.

The finals of the competition, which is organised by IMechE and attracts over 100 teams from universities in the UK and worldwide, takes place this month at the Silverstone race circuit. In previous years, use of biofuels was optional, but this year it will be compulsory to reduce emissions and encourage students to gain experience using the fuels.

David Richardson, Director at Coryton, said: "With the past two Formula Student winners using SUSTAIN Racing 100E fuel, we've proven the performance potential of sustainable fuels alongside their ability to reduce greenhouse gas emissions."

Fiona Wong, Formula Student Project Manager, said: "Our partnership with Coryton is an important way of allowing students to develop their experience of internal combustion vehicle technology. As engineers in industry work toward Net Zero targets, these sustainable fuels allow us to demonstrate how motorsport can contribute toward a lower-carbon future."

The Formula Student competition challenges engineering students to design, manufacture and run a single-seater race car. Complementing their academic studies with a real-world engineering project, the competition provides opportunities for students to broaden their knowledge, practical skills and teamwork abilities.

ABOVE The SUSTAIN-fuelled Edith Cowan University squad won in 2024

The 35 entrants in 2025 running petrol engines have been given the choice of fuelling with SUSTAIN Racing 100E (107 RON), which is 82% ethanol, or SUSTAIN 100 (95 RON) which is 10% ethanol. These blends comprise 100% sustainable materials and are designed as a drop-in solution, meaning student teams won't need to make alterations to the combustion engines used at the competition, whilst producing significantly reduced emissions.

These SUSTAIN products use advanced second-generation biofuel manufactured from agricultural waste, such as straw, by-products or waste from crops which wouldn't be used for consumption. The fuels being used at the event will offer an 85% reduction in greenhouse gas emissions compared to fossil fuel, when calculated using a full life cycle analysis. RT

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- **PDM-5** can be configured to become a dedicated Headlight or Spot Lamp controller.
- **PDM-4C** incorporates CAN Bus connectivity for transmitting diagnostic data including output status, volts, amps, configuration settings, etc. Outputs can also be controlled through CAN Bus.

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Porsche

Porsche reveals road-legal 963 Hypercar

PORSCHE revealed a one-off, road-going version of its championship-winning LMDh car, named the 963 RSP, in the build up to Le Mans.

The car commemorates the 50th anniversary of the commission of a road-legal version of the 917 that won back-to-back editions of the French endurance classic in 1970 and 1971. That car made an extraordinary journey, not on the track, but on public roads, from the factory in Zuffenhausen to Paris.

The 963 RSP is the work of a team from Porsche AG, Porsche Penske Motorsport and Porsche Cars North America in partnership with motorsport legend Roger Penske, whose initials form the name of the car.

"This really started out as a 'what if?' – a passion project by a small team of enthusiasts at Penske and at Porsche who together imagined a version of the 963 that really resembled as closely as possible the spirit and appearance of the Count Rossi 917," said Porsche Cars North America President and CEO Timo Resch, who conceived the original idea.

"The 917 from the story was every inch a race car – albeit one driven on the road – and we took the same approach with the 963 RSP. It uses beautiful materials of the best quality available, but is still every bit a race car underneath."

The 963 RSP features significant changes over the car on which it is based. In a nod to the Count Rossi 917, the 963 RSP is finished in Martini Silver and features uniquely altered bodywork and a bespoke tan leather and Alcantara interior inspired by the trim choices made by Count Rossi 50 years ago.

A dedicated mechanical and electronic setup were configured for its debut on the streets near Le Mans – including a raised ride height and the softest setting of the adjustable Multimatic DSSV dampers to create a more compliant ride. A reprogrammed control unit allowed for the headlights and taillights to operate closer to those of a road car.

To closer align the 963 to the form of the 917, bodywork changes included the creation of unique fender vents and the removal of the carbon fibre blanking plates that sit within the rear wing.

The hybrid V8 powertrain with a lithium-ion battery – capable of being run on electrical power only – remains in standard race tune in the 963 RSP, but power delivery from the MGU has been remapped to provide smooth delivery more appropriate for road use. The powertrain was also re-mapped to be capable of running on pump gas – a significant undertaking for the team.

In July the car will appear alongside the 917 at the Goodwood Festival of Speed. RT

Tyre recycling pilot declared a success

MOTORSPORT Australia took aim at one of the sport's trickiest problems last month. It partnered with Tyrecycle, Australia's largest collector and recycler of end-of-life tyres, to launch a tyre recycling pilot program at The Bend Motorsport Park.

In spite of efforts across different disciplines, tyres remain a significant waste product for motorsport.

Sunil Vohra, CEO of Motorsport Australia, expects the learnings from the pilot event to inform the feasibility of integrating tyre recycling logistics into motorsport events.

"By partnering with Tyrecycle we're leveraging industry-leading expertise in resource recovery to trial practical, sustainable solutions tailored to the unique demands of motorsport events," Vohra said.

"The pilot program supports further investment in aligning motorsport activities with circular economy practices. Tyrecycle provides the critical link between tyre disposal and material reuse."

Jim Fairweather, CEO of Tyrecycle, believes that working with Motorsport Australia will help to raise awareness about the opportunities and benefits of adopting sustainable practices across all levels of the motorsport industry.

"We've been able to offer racing competitors and motorsport administrators a convenient and safe way to manage end of life tyres," Fairweather said.

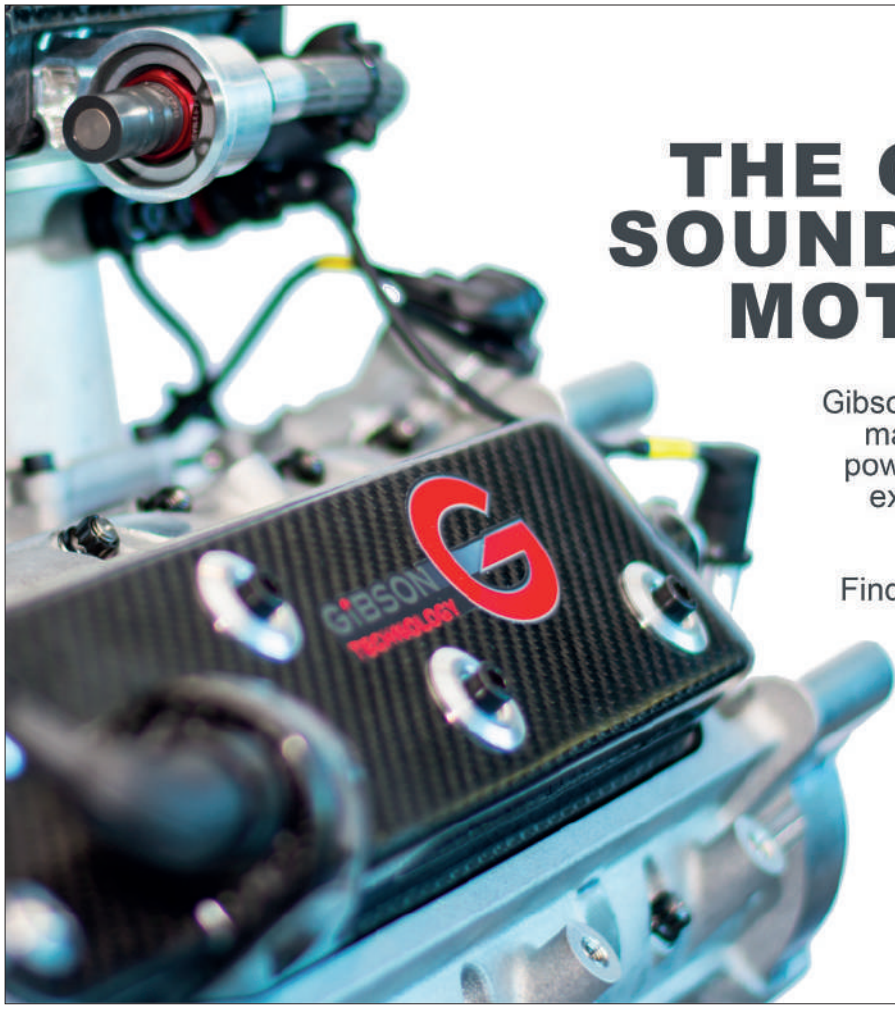
"Effective sustainability strategies require accurate, event-specific data. This tyre recycling pilot was designed not only to divert waste but also to generate insights into the types and volumes of tyres used, logistical considerations for on-site collection, and the viability of downstream recycling processes."

The pilot exceeded expectations, with 168 tyres recycled during the three-day event.

Tyrecycle's recycled rubber crumb and granules are used in a wide range of applications, including in tile adhesives, playgrounds and sporting fields, but are most widely used in the construction and resurfacing of roads.

Motorsport Australia says it will continue to work towards an industry wide goal of 100 per cent tyre recycling through a model that is compatible with the demanding realities of motorsport events. RT

LEFT Sustainable tyre disposal trial didn't compromise event efficiency



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PFC and Xtrac confirmed for new IndyCar

INDYCAR has provided a status update on the new racecar the series will introduce for the 2028 season, confirming that existing suppliers like P Performance Friction Corporation and Xtrac will continue to be involved.

"The time has come for a new NTT INDYCAR SERIES chassis," INDYCAR President J. Douglas Boles said. "The DW12 served the series so well, as it provided a combination of phenomenal, wheel-to-wheel racing and critical enhancements to safety. But recent significant updates to the car – from the aeroscreen to the hybrid power unit – have helped advance the need for a completely new car.

"We are pleased by what our engineers and Dallara have collaboratively designed and believe it will appeal to the fans and paddock while also upholding our standards of safety and enhancing INDYCAR's on-track competition well into the future."

Working in tandem with Dallara and other component suppliers, the overall car design includes a projected weight reduction of 85-100 pounds compared to the current chassis.

Plans also include a move to a 2.4-litre twin-turbocharged V6 internal combustion engine, which is expected to provide more torque and power over the current engine formula.

Xtrac, an exclusive supplier for INDYCAR since 2000, will continue to provide transmissions for the new chassis. Development for 2028 includes a gearbox that will shed 25 pounds from the currently used unit and one that will share components with a future INDY NXT by Firestone gearbox – streamlining components for teams also involved in INDYCAR's development series.

Low-voltage hybrid engine technology, introduced to series competition with a successful launch in July 2024, will continue to evolve in the new car with longer deployment, more horsepower gain and overall improved performance.

Performance Friction Corporation (PFC) once again will be the exclusive supplier of brake system components for the series, as it has since 2017.

Safety also will continue to be a focus of Dallara's design, in close collaboration with INDYCAR technical and medical response officials. The new car will bolster safety to new benchmarks with an ergonomic driver cockpit to improve seating position, an integrated aeroscreen and a new roll hoop. The existing chassis was retrofitted with the aeroscreen upon that revolutionary safety device's introduction in 2020. RT

BELOW IndyCar will transition to a 2.4-litre V6 when the DW12 is replaced

Penske Entertainment

Honda mounts FCEV Pikes Peak assault

HONDA'S CRV e:FCEV has become the first hydrogen-powered vehicle to compete at the iconic "Race to the Clouds" – The Pikes Peak International Hill Climb.

Prepped for competition by engineers at Honda of America Race Team (HART), Honda R&D Japan, and Honda Racing Corporation USA, the CRV e:FCEV took on the shortened mountain course with two-time Formula Drift champion and HRC US driver Dai Yoshihara at the wheel.

The production 2025 CRV e:FCEV competed in the "exhibition class" without modifications to its zero-emissions powertrain, which includes the second-generation Honda fuel cell system produced at Fuel Cell System Manufacturing, LLC (FCSM) in Michigan, a front-mounted single-motor, 17.7 kWh battery pack, and two high-pressure hydrogen tanks.

The CRV e:FCEV is hand-built at the Honda Performance Manufacturing Center (PMC) in Marysville, Ohio, and is the only fuel cell electric passenger vehicle made in America, and the first to pair hydrogen fuel cell with plug-in hybrid technology.

For competition, the only modifications from stock were a one-inch lower suspension, racing brake pads, lightweight 18-inch wheels and 265/45R18 Yokohama Advan A052 tyres. HART also equipped the CRV e:FCEV with a racing seat and safety cage, custom-fabricated into the vehicle by Honda engineers at HART and PMC.

Hydrogen fuelling was provided by Zero Emission Industries (ZEI) during the event. The company's new FTcase, a portable hydrogen refuelling solution barely larger than carry-on luggage, was used.

Honda has a long history of zero-emissions competition at Pikes Peak, dating back to 1994 when the company entered into the first-ever "EV Class".

Honda has been conducting research and development of hydrogen technologies and fuel cell electric vehicles (FCEV) for more than 30 years. Successes have included the first government fleet customers and first retail customer leasing programme for fuel cell electric vehicles. The company's market experience with hydrogen fuel cell vehicles began with the introduction of the Honda FCX in December 2002. RT

BELOW The car finished 69th overall out of 73 entries and third in class

Horse Powertrain to supply engine for US-built ARC2 rally car

HORSE POWERTRAIN, via its Aurobay Technologies division, has signed an agreement to supply engines for the ARC2, a new rally car developed by US-based JRD Motorsport for the American Rally Association's RC2 class.

The ARC2 will use a 2.0-litre turbocharged engine manufactured in Sweden by Aurobay Technologies. The unit will be delivered fully assembled and fitted with a locked ECU and tamper-proof seals to ensure regulatory compliance. It will be paired with a five-speed sequential gearbox supplied by SGS Racing Transmission.

Matias Giannini, CEO of Horse Powertrain, said: "This is an exciting moment for Horse Powertrain, marking our first direct deal with a US customer. I believe our solutions and expertise can be of great value to automakers and OEMs in this region. This agreement also highlights the versatility and competitiveness of our technologies in motorsport applications."

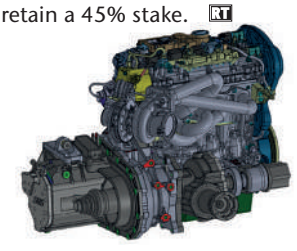
JRD Motorsport is building the ARC2 on the Chevrolet Sonic platform. The car includes an all-wheel-drive system, FIA-certified roll cage, and proprietary suspension geometry developed in-house. The vehicle is aimed at offering Rally2-level performance at a lower cost than imported European alternatives.

Johan Ragnarsson, CEO of JRD Motorsport, said: "Our objective has been to provide a competitive, reliable car that is affordable for American teams. Horse Powertrain's engine has been essential in achieving this, allowing our new ARC2 rally car to offer world-class performance to racers at a very competitive value."

The ARC2 will be unveiled at the Performance Racing Industry (PRI) Show in Indianapolis in December. Testing is scheduled to begin late 2025, with deliveries expected in early 2026.

Aramco recently acquired a 10% equity stake in Horse Powertrain Limited, with the two companies leveraging their collective expertise and resources to pursue advances in powertrain technologies, synthetic fuels, and lubricants.

Renault Group and Geely (through Geely Holding and Geely Auto) each retain a 45% stake. RT



ABOVE The ARC2 engine seen in CAD

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"Each year, the World Motorsport Symposium brings together a distinguished group of racing experts, each of which is an impactful leader in their field. Their knowledge, insight and transparency on the critical challenges and vision of motorsport make this event essential for industry professionals."

BERNARD NICLOT
ACO's Mission H24 Innovation Director

"The Automotive World is, with each passing year, more and more difficult to predict. The target is well known: Zero CO2; but the way to achieve it on a large scale is dramatically challenging. In such a period, the World Motorsport Symposium, being so open-minded, is very valuable to share and challenge ideas and solutions not just for motorsport, but for motorsport as a lab for future road mobility."

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WHAT THEY SAID...

DR VALERIA LORETI
Delivery Manager Motorsport, Fuels Technology Group, Shell Global Solutions (Deutschland) GmbH

"Participating in WMS 2024 was not only a great opportunity to hear directly from technical experts on a number of relevant and stimulating topics, but also the opportunity for networking and establishing those key relationships that are the basis for further development and exciting breakthrough steps."

DAVID SALTERS
President of Honda Racing Corporation USA (HRC US)

"I really appreciate the effort that goes into the Symposium, the straightforward open discussion, informed debate and reflection."

ERIC JACUZZI
Vice President, Vehicle Performance at NASCAR

"Another great learning experience for the two of us that attended from NASCAR. The topics were very relevant to the future of motorsport, and challenged us to look deeper into some areas of development that we had not previously considered or perhaps considered seriously enough. As always, the collegial atmosphere and lively debates and conversations make for a great event. I am looking forward to seeing everyone again next year and hearing about the advancements another year brings."

ULRICH BARETZKY
Former Director, Audi Motorsport Engine Development, Audi AG

"The 2024 WMS in the famous Royal Automobile Club was very special, a real highlight to mark the event's 20th anniversary. The quality of presentations, as well as the respective discussions in this very special atmosphere, really makes me look forward to the 2025 event."

ALAN PATTERSON
Founder, BeyondMath

"WMS is the one event that brings together all the leaders in motorsport under one roof. As a startup, this is invaluable for us."

SERGE GRISIN
Motorsport Director, Symbio

"I was truly impressed by the quality of the discussions, the insightful exchanges with leading experts in motorsport and technology, the spirit of openness and constructive dialogue, and the overall sense of shaping not only the future of motorsport but also, and more importantly, the future of mobility. A future that aspires to be more sustainable."

FAST EDDIE THE HUSTLER

The British Grand Prix was the spiritual home of Eddie Jordan, the maverick who took on the might of F1's constructors as an independent – and sometimes beat them. By **Tony Dodgins**

EDMUND Patrick Jordan was born great at maths but mildly dyslexic, which was no great problem because no-one could predict what was likely to come out of his mouth at any given time. When they made EJ they truly did throw away the mould. And that expression about not so much kissing the Blarney Stone as swallowing it whole, was him to a tee.

Born and brought up in Dublin, there was dentistry in the family but EJ ran screaming from that after a couple of lectures. A born wheeler-dealer, at the end of a school year he bought up books in better nick than his own and sold them to the next year's class. Banking, he thought, was much more suitable. But a second banking strike when he was in his early twenties meant a move to Jersey to do odd jobs while making ends meet. While there he discovered karting and was hooked.

Most in the world's racing paddocks over the past 40-odd years knew that Jordan wore a wig. Certain members of the media became aware of it when some of the lads working for EJ's F3000 team went into a joke shop, bought a hairpiece and lobbed it into a swimming pool beside him after Jordan dived in. He surfaced, saw the floating hair and, in panic, grabbed at his head, to much mirth!

Eddie's alopecia was not, as some thought, the result of an accident in Formula Atlantic, it was more dramatic than that. In the karting days in the village of Monasterboyce, north of Dublin, practice was going on when a chap called Barney, famous for having just one useable arm, decided to lap the circuit in the opposite direction... He encountered EJ head-on and a monumental shunt left Jordan with a compound leg fracture, which became infected and led to three weeks in hospital, an affected nervous system and the alopecia.

Undeterred, Jordan was determined to graduate to cars. An Irish cultural hub at the time was the Dandelion Green flea market (now the St Stephens Shopping Centre), where U2 played some of their first gigs and EJ sold carpets and rugs on a Saturday morning. Following an accountancy course he landed a job as a clerk in what would become Bank of Ireland. Anyone coming in for a car loan got more than they bargained for – usually one of EJ's second-hand bangers!

As too, did the luckless policeman who stopped Jordan en route from Dublin to Mondello Park going at what EJ's mates feared was a highly serious speed in a Triumph 2.5pi. Anticipating a ban and potential walk home, they were astonished when Jordan returned ticketless from the patrol car with an agreement in principle to sell the officer a car the following Tuesday...

Jordan soon had the funds in place to move into Formula Ford 1600 and bought himself a Lotus 61 which, he believed, wasn't very good. He moved it on, to a certain Derek Daly, who would go on to count Williams among six F1 teams he drove for. At the time though, Jordan was slightly uncomfortable when Daly started to win races with his old car.

EJ then got hold of a Crossle, which he described as a much better car. He headed for England but badly broke his legs in a crash at Mallory Park. While recuperating,

Jordan, now 27, contemplated packing it in. But he got a call from a preparation specialist whose driver was moving on, offering a chance to move up to Formula Atlantic in Ireland. For 1977 they bought an ex-Alan Jones March, which is when he met Vivian Candy, another Irishman, who was active in the advertising world and heard that Marlboro wanted to break into the UK and Irish markets. EJ's gift of the gab helped parlay that into Marlboro Team Ireland, for which Jordan won the Irish Formula Atlantic title in 1978.

By this stage EJ had met Marie McCarthy, an international basketball player for the Irish under 21 team and they were married in January 1979. On the back of his Atlantic success, Jordan persuaded Marlboro to finance a two-car team in the British F3 championship with Stefan Johansson in the other car.

That meant basing himself in England and, while Marie finished her training as a computer programmer with Price Waterhouse, Eddie took leave from the bank. They rented a room from Alan Docking before buying their first house in Silverstone village for £3000.

Hanging up the helmet

The F3 competition that year was tough. Brazilian Chico Serra won the title and others who went on to F1 as well as Johansson were Nigel Mansell, Andrea de ▶

BELOW The late Eddie Jordan was the man who gave Michael Schumacher his Formula 1 debut at the 1991 Belgian Grand Prix – though the partnership lasted only one race

Getty Images

Cesaris and Mike Thackwell. Jordan, now 31, realised he wasn't going to be a top-line driver. After some sportscar outings, which included being one of the first to arrive on the scene of Jean-Louis Lafosse's fatal accident at Le Mans, he elected to hang up his helmet and form Eddie Jordan Racing. As he said, "It was time to concentrate on the guys who really could drive."

Early EJR drivers included David Sears, David Leslie and James Weaver and there was always a deal to be done. One such involved running Wyatt Stanley, a friend of the UB40 reggae band, in an F3 car at Dijon for £1700. Even Jordan was temporarily lost for words when Stanley, who owned a number of Birmingham bingo halls but hadn't had time to go to the bank, turned up with sacks full of ten pence pieces!

Jordan, while fond of his music and his golf, had a strong work ethic and boundless energy so his small Silverstone-based team soon became competitive and respected. The 1983 British F3 season in which Martin Brundle in Jordan's Ralt took Ayrton Senna and West Surrey Racing to the wire for the championship, really put the team on the map. In the early days Jordan was aided by others with similar qualities and racing in the blood, such as fellow Irishmen John Walton, Bosco Quinn and Gary Anderson. Andy Stevenson, who joined the team in 1987, still remains with the team that is now unrecognisable as Aston Martin.

After winning the 1987 British F3 title with Johnny Herbert and a Reynard that EJ never paid for (because it was selling cars for Adrian and Rick Gorne!) EJR moved up to F3000 with Herbert the following season. Herbert had talent but no funding and it was with Johnny that EJ moved more seriously into the driver management side of things, having formed Eddie Jordan Management (EJM) in 1983.

LEFT Jordan gave Ayrton Senna his first F3 test in a Ralt RT3/82 at Silverstone in 1982. Three years later he won in F1 at a drenched Estoril

Newspress

They headed to the first F3000 race at Jerez with a free Reynard but no money to run it. Herbert, despite not knowing the track, put the car on pole. EJ, knowing cigarette company Camel was less than enamoured with the performance of their Lotus cars in F1, telephoned Duncan Lee, Camel's sponsorship chief. He asked for permission to adorn Herbert's virgin white car in Camel stickers for no consideration but the promise of a meeting the following Tuesday if Herbert won. He did, and by the end of the next week, Jordan had a Camel deal for F3000.

Herbert was very much hot property and courted by Benetton, Lotus and Williams but a mid-season crash at Brands Hatch left him with severe foot and leg injuries, from which he somehow recovered sufficiently to be able to start the 1989 F1 season with Benetton.

Jordan then signed Jean Alesi to partner Martin Donnelly. Alesi won the F3000 title for Jordan in 1989 and made a starring F1 debut in France after Jordan negotiated drives for both Alesi and Donnelly at the French GP, with Tyrrell and Arrows respectively.

After running his team for a decade, by the end of the eighties EJ had won the F3 and F3000 titles. Through those victories, EJM and his other wheeler-dealing, he had around £5m in the bank having just turned 40.

Swimming with piranhas

In his autobiography, *An Independent Man*, Jordan says: "The question I asked myself was this: 'Do I hang onto the money and do Formula 3000 again? I can be at the top of this for some time and make a couple of hundred grand each year. As a useful aside I can bring drivers into F1 and there is no conflict. It would be safe."

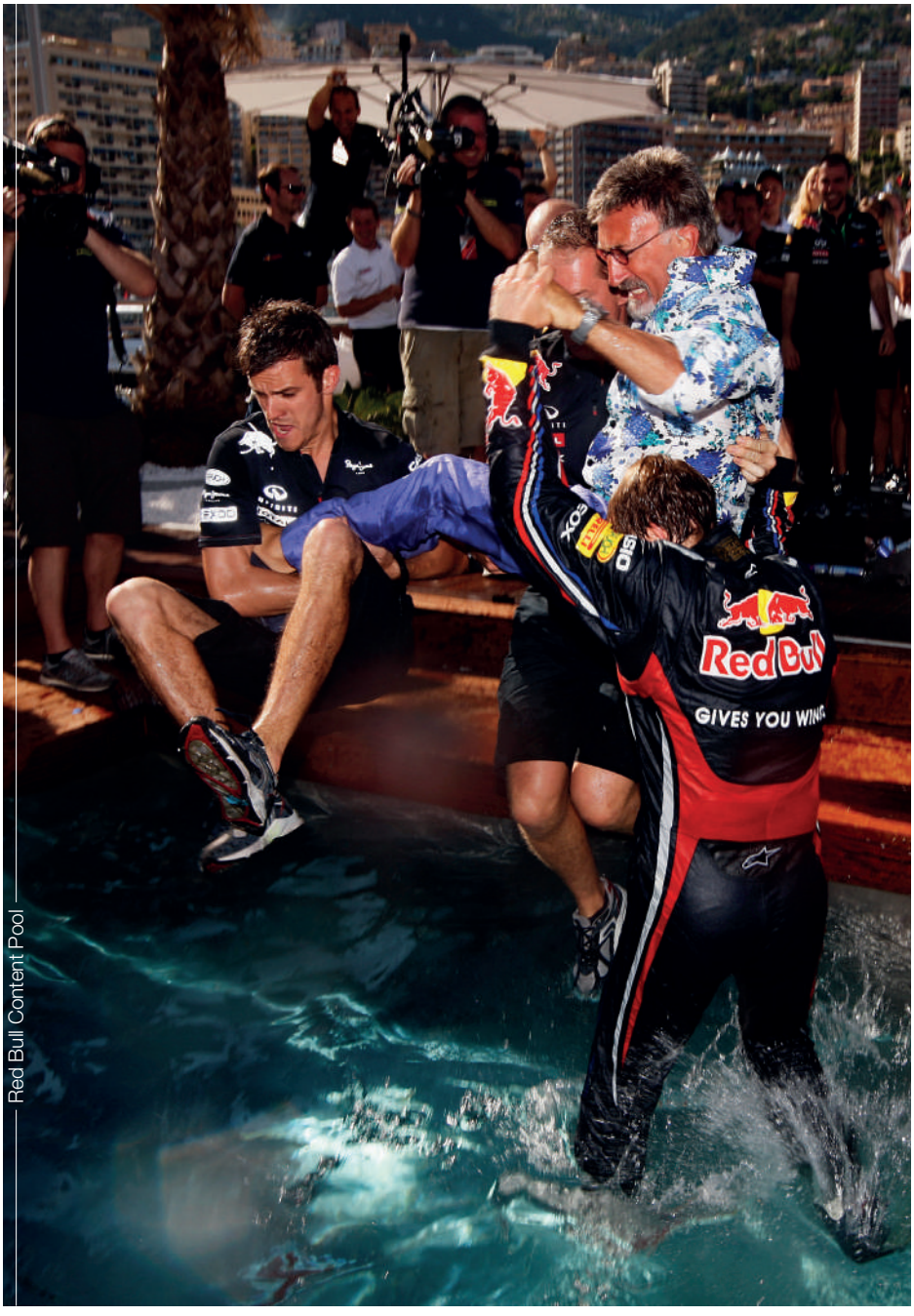
Or... did he try for F1, an altogether different challenge, and risk blowing not just his £5m but whatever sponsorship he could raise, then have a debt at the end if it all went wrong?

While many would 'stick', men like EJ always 'twist.'

To her great credit Marie Jordan, knowing her husband, told him to go for it. Not two years on, they were up to their necks in debt and facing a winding up order from Cosworth over unpaid F1 engine bills.

Gary Anderson had designed Jordan's gorgeous-looking first F1 car for 1991, which EJ had named the Jordan 911 (91 season, F1). Which was fine until Porsche pointed out he couldn't because they had the rights to '911.' Jordan imaginatively exploded that all his registrations and promotional material had been done and printed – and that changing the designation to '191' was going to cost a fortune, and that he believed Porsche's rights extended only as far as road cars. Only EJ could end up with a free shiny black 911 on his driveway in return for a designation change...

By the end of 1991 a rough calculation showed Jordan he had gone from £5m up 12 months earlier, to £5m down. He gave short shrift to those who later suggested he'd been a bit cheeky and greedy taking £150,000 for Michael Schumacher's Spa F1 debut (paid by Mercedes) after Jordan driver Bertrand Gachot ended up in jail for spraying mace in a taxi driver's face. First off, Jordan always said, the extent of Schumacher's talent ▶



Red Bull Content Pool

BELOW Eddie Jordan's face at Red Bull's Monaco Grand Prix celebrations betrays his terror at the prospect of parting with his wig on global TV

Getty Images

RIGHT Jordan Grand Prix's finest hour came at Spa in 1998 when Damon Hill led Ralf Schumacher to a famous one-two in the rain

wasn't obvious at the time, and second, money to pay the mounting bills had to come from somewhere!

With F1 known as 'the Piranha Club' Jordan gained first-hand experience when he lost Schumacher to Benetton after just one race through contractual jiggery-pokery and background political machinations. Bernie Ecclestone was instrumental in steering Schumacher and his manager away from Jordan because he was busy setting up a Yamaha engine deal for Jordan in the background and he knew they wouldn't be competitive!

How did Jordan get out of their Cosworth predicament? First, they bought time by arguing in court that they were being overcharged for rebuilds: the judge duly denied the winding-up order and told them to sort it out between them. Second, by saying that Schumacher was obviously a future star, placing an astronomical figure on the Jordan 191 in which he made his F1 debut and presenting it to Cosworth as a downpayment! They paid the rest via instalments the following year, helped by new Sasol sponsorship and the free but hopeless Yamaha engines, after Yamaha had bought Ecclestone's old Chessington Brabham factory. It's how F1 works, an environment that might have been made for a chancer like EJ.

> *"Jordan gained first-hand experience of 'the Piranha club' when he lost Schumacher to Benetton after just one race"*

Eddie Irvine was another shrewd Irishman and one of the few to get one over on EJ. He had replaced Alesi in the F3000 team for 1990 but, when an F1 chance did not materialise, he headed for Japan with an eye on making some money. In 1993 Jordan brought him back to drive in F1 at Suzuka, which Irvine knew like the back of his hand, before partnering him with Rubens Barrichello at Jordan-Peugeot for 1994-5.

Schumacher, by then a double world champion with Benetton, was leaving for Ferrari and it wasn't clear who his team-mate was going to be. Irvine and his manager had already been in contact with Niki Lauda, then a Ferrari consultant, who was baulking at the money EJ wanted to release him from his 1996 Jordan contract. EJ, meanwhile, went direct to Schumacher and convinced him Irvine would be a competent and obedient team-mate if the money was right.

Jean Todt, Ferrari's team principal, asked Jordan how much Irvine would need and when EJ mentioned figures between $4-$6m, told him he was quite mad but nevertheless asked to see Irvine.

Irvine had also been talking to Ligier, then run by Tom Walkinshaw. But, said Jordan, "the chances of Walkinshaw paying me some money (to get Irvine out of his Jordan contract) were so slim I reckoned Admiral Nelson had a better chance of getting his eye back..."

It was Marlboro who paid the Ferrari driver retainers and when Luca di Montezemolo told Jordan that he was looking for too much money and didn't understand the value of the driver market, Jordan told him Gitanes and Ligier were desperate to have Irvine and potentially increase Gitanes' penetration in the UK cigarette market. He also claimed the loss of Irvine would disrupt his team, with a ▶

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decent replacement costing him serious money. In his book, Jordan says: "After much to-ing and fro-ing we agreed a figure of $5m. I could hardly believe this was happening. It was daylight robbery and I was the one wearing the mask!"

This, of course, would become a four-year arrangement and, in his head, Jordan was no doubt already spending his commission! Irvine had not been party to the negotiation at Marlboro's Swiss HQ, waiting nearby instead. When an excited Jordan told him about the deal, Irvine grimaced and said playing second fiddle to Schumacher was potentially a career-ender. He added that he got on with EJ, loved the team and thought he was going to stay; that it would be better for him.

"This was classic Irvine," Jordan said. "That's why he was so far ahead of his rivals when it came to being streetwise. Very cunning and very sharp." He did sign the contract of course, but only when EJ agreed to reduce the commission.

Still rocking the boat

Benson & Hedges sponsorship raised Jordan's level and increased both the staffing numbers and the aspirations, even though the rock'n'roll nature of the team remained the same. Having finished in the constructors' championship top five for the third time in four seasons, Jordan signed 1996 world champion Damon Hill for 1998 after he was dropped by Williams and spent a year at Arrows.

"I never believed for a moment that Damon would consider coming to Jordan," EJ admitted. They already had an association when Jordan had some Barclay (a subsidiary of BAT) money for 1991 but he couldn't use the sponsorship on the F1 car because of Andrea de Cesaris's clashing Marlboro backing. A deal was done with Middlebridge, who Hill was driving for in F3000.

"I later discovered that Damon had written a vicious letter to the marketing director of BAT urging them not to be associated with me and more or less saying ▶

Newspress

LEFT Martin Brundle is one of many drivers who owe their big break to Eddie Jordan after his famous season battling Ayrton Senna in British F3

Ferrari

LEFT Eddie Irvine, one of few drivers who could take on Jordan at the negotiating table, ended up with a plum deal at Ferrari

BELOW Jordan Grand Prix amassed an impressive collection of Formula 1 silverware as it battled the sport's greatest manufacturers

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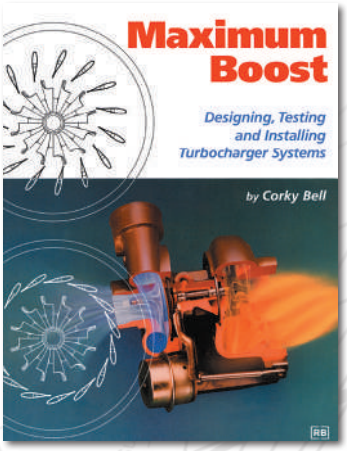

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that I was a crook," Jordan explained in his book. "We had never spoken about it but my underlying feeling was that he would not trust us as a team."

The start of 1998 did not go well, Hill and team-mate Ralf Schumacher finding the Jordan 198 uncompetitive. The pressures were getting to Jordan who, having just turned 50, still owned 100% of the team and was starting to feel exposed.

After four years with Peugeot engines, Jordan had done a deal for Mugen-Hondas for 1998. There were rumours that Honda was thinking about a works return after leaving F1 in 1992, and Jordan could sniff a potential deal. After a disastrous Monaco GP he read the riot act, made personnel changes and demanded a big mid-season upgrade.

At a rainy Spa, Jordan GP achieved EJ's holy grail when Hill led Schumacher, who obeyed team orders to stay behind, to a 1-2. At a meeting with Honda's CEO Nobohiko Kawamoto, the Japanese offered to buy 100% of the team. EJ wanted to retain 10%, which was agreed, but on the condition that he did not work there, Honda explaining that in motorsport at that time, the Jordan brand was better known than Honda. Not ready to let go at that stage, EJ declined. He then sold 49.9% of the team to private equity company Warburg Pincus.

Meanwhile, Michael Schumacher had been less than impressed by his brother's instruction to stay behind Hill at Spa and told him it was time to move on. The release fee, which Michael allegedly paid Jordan, was much more than Jordan paid his replacement, Heinz-Harald Frentzen, so EJ came out ahead yet again.

The 1999 season was Jordan's best. Frentzen won at Magny-Cours and Monza and even looked like mounting a title challenge at one point, the team ultimately finishing third in the constructors' championship behind Ferrari and McLaren.

When Jordan had declined to sell the team in its entirety to Honda, the Japanese put their works effort behind the new British American Racing team. Although Jordan scored more points than BAR in

> *"The deal-maker extraordinaire sprung a surprise when he appeared as Adrian Newey's agent"*

RIGHT Jordan had a chance to get his own back on Formula 1's Piranha Club during his stint as a TV pundit

RIGHT The coda to Jordan's astonishing motorsport career came when he brokered Adrian Newey's switch to Aston Martin for 2025

BELOW Eddie Jordan was a colourful character in the world's motorsport paddocks during his rise to the highest echelon of all

2002, this was the final year of its Honda association. Or at least the Japanese thought it was, believing the contract was two years firm with three years of options, while EJ himself claimed three years firm and two years of options. To end the contract 'early' Honda compensated Jordan $22m to be spent on future engine costs and Jordan returned to Cosworth for the first time since its debut season, with the money to pay them this time!

After the smoke clears

The team scored its fourth and final win at the 2003 Brazilian GP, a combination of good strategy and a race stoppage working in their favour. But the writing was on the wall. The F1 landscape was changing. Tobacco sponsorship was on the way out and ever-increasing major manufacturer presence and spend was making the outlook bleak for teams like Jordan.

During the final third of 2004, keeping the team going was costing Jordan half a million dollars a month and any new blue-chip sponsors were aligning themselves with manufacturer teams. Interest was being expressed by a number of potential investors but negotiations were dragging. Jordan received a call from Bernie Ecclestone, who he had already spoken to about a potential advance payment on F1 TV money to finance the 2005 car build.

Ecclestone told him: "I don't really care about you, Jordan. I have much more interest in your family and your team. I'm concerned that you are putting everything at risk without them knowing. Jordan has surprised everyone, including me. You've brought great credit to yourself and F1, but I don't want to see that go up in smoke."

With that, he took EJ into an adjoining room and introduced him to a Russian-born Canadian billionaire, Alex Shnaider, who was interested in buying the team. A deal was struck and Jordan Grand Prix became Midland F1 in 2005. When the Melbourne GP kicked off the year in March, EJ was aboard a 180ft sailing ketch in the Persian Gulf on a trip arranged by Marie to take his mind off it. His days as a team owner were over.

Jordan then turned his fertile mind to business and charity pursuits, doing sterling work for the CLIC children's cancer charity in particular. He became an OBE in 2012 for services to charity and motorsport, while staying in touch with F1 via punditry roles with the BBC and Channel 4. Then, as deal-maker extraordinaire, he sprung a surprise when he appeared as Adrian Newey's agent in the recent multi-million pound stakeholder deal that saw the design ace join Aston Martin on a long-term contract. Who knows, perhaps EJ's fondness for the site on which his team started life, not to mention his persuasive powers, played a role in beating Ferrari to the signature!

EJ's business interests ranged from property and commercial real estate, through gaming and entertainment interests, horse racing to health and fitness. A Coventry City and Chelsea fan, he had a stake in Celtic and was involved with the Jordan Group consortium that recently took London Irish RFC out of administration, leaving son Kyle as interim CEO.

When Eddie Jordan succumbed to cancer a few days before his 77th birthday in March, he had amassed an estimated £450m fortune. Not bad for the ultimate chancer who started off in Alan Docking's spare room 45 years earlier! There truly won't be another like him. He is survived by wife of 46 years, Marie, and children Zoe, Miki, Zak and Kyle. RT

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Aston Martin Aramco F1

DYNAMIC PROGRESS

Chris Pickering investigates Bramble CFD, a cloud-based platform spun out from TotalSim, that was used by Formula 1 to develop its current generation car

Getty Images / Red Bull Content Pool

THE role of computational fluid dynamics (CFD) in motorsport is evolving. Increasingly, multi-manufacturer championships are subject to balance of performance (BoP) regulations that define an aerodynamic performance window for each car. Elsewhere, single make championships and spec aero kits are becoming ever more prevalent, which means that teams have to focus on getting the best out of a standard package. Meanwhile, the ever-increasing speed and fidelity of CFD is turning it into a practical tool for applications where it would have been too slow or too expensive previously.

"We've seen a big uptake in aero mapping work in CFD," comments Ivor Annetts, managing director of Bramble CFD. "Traditionally, you'd run the car in CFD in one or maybe two positions during development then take it to the wind tunnel for all the ride height sweeps. But we're now at the point where people are doing that in CFD."

He attributes this partly to the rise of CFD tools like Bramble, which automate much of the CFD process and make it far easier to iterate through different setups on the same model. Meanwhile, the desire to find a competitive edge is driving teams to push beyond the relatively basic aero maps that are often provided by the manufacturers.

"Access to more detailed aero data means that ▶

> *"The accuracy of CFD simulations is way beyond where it was even five years ago"*

BELOW Bramble CFD's technology was used in the development of the current breed of Formula 1 cars that made its debut in 2022

teams are better placed to set the car up and validate what they've seen on the track. In many cases, the teams aren't allowed to do any wind tunnel testing, so they use high-fidelity CFD simulations instead. And the accuracy of those is way beyond where it was even five years ago. What might have been a steady state RANS simulation back then might now be run as a transient DES simulation, where you actually model the air oscillating and things like that," Annetts continues.

The enabling factor here is cost. Detached Eddy Simulation (DES) was once the preserve of scientific models churning away on supercomputers for weeks on end. It has become increasingly viable as access to high performance computing has come down in price, but there has been a step change with the arrival of GPU codes.

Graphics processing units (GPUs) were originally designed to accelerate image rendering, but their parallel processing capabilities also make them very adept at tasks like solving CFD codes and training machine learning algorithms. Initially, some CFD software companies tapped into this by adapting their existing CPU-based codes to run on GPUs, but they were still reliant on the CPUs for parts of the process, which slowed the whole thing down. Since then, most have launched dedicated GPU codes, designed from the ground up to take advantage of the new architecture, with stunning results.

"Computing power has been gradually improving CFD over the years, but I don't think I've seen the step change that GPU codes have brought," says Annetts. "We're not talking a 10 per cent increase or a 20 per cent increase, suddenly these codes can be five or six times faster than they used to be. A large simulation that used to

RIGHT The Artec Leo, a handheld wireless scanner, captures surface data accurate to 0.1mm and a resolution of 0.2mm

LEFT & ABOVE LEFT Bramble CFD's TotalSim sister company Catesby Projects recently had the chance to 3D scan and provide aerodynamic development for an electric VW Beetle, built for Pikes Peak by Richard Morgan from Electric Classic Cars

> *You do need a good quality scan to get reliable results from the CFD”*

take 24 hours might now be four hours if you throw enough GPUs at it.”

There is a caveat here. In Formula 1, the use of GPU codes is banned, but this is tied to the way that the teams’ CFD usage is restricted and monitored rather than any fundamental issue with the technology. It also means that teams who have recently invested in conventional CPU clusters don’t have to replace them with GPU clusters to remain competitive. Elsewhere in motorsport, this restriction generally doesn’t apply.

Scanned geometry

It’s common for customer cars or those in spec series to be supplied without a CAD model. In those cases, the only option for teams looking to carry out CFD testing is to reverse engineer the car to create their own. The key enabler here is 3D scanning technology, which has improved significantly in recent years.

“It’s much easier to get things scanned than it used to be and the quality of the scanned data is now excellent,” explains Annetts. “In some cases, scanning the car is the only option, but you might still do it even if you have access to the CAD data. That’s because the CAD tends to be very sanitised, and it might not necessarily reflect what’s being manufactured. For instance, the scanner will pick up panel gaps or bolt holes that might not be in the CAD. Initially, it was quite a novel approach, but what we’ve found is that engineers will do it once and then move to another team, bringing this methodology with them.”

Creating a CFD-ready CAD model with 3D scanning is not a trivial process. Annetts says that the initial scanning would generally take around two days – combining a whole vehicle scan, with additional scans of sections removed from the car and a scan of the underside. It’s also useful to scan the tyres under a variety of loading conditions – especially on single seaters, where they play a major role in the flow around the car.

The sidewalls can be scanned directly, with a plaster of Paris mould used to capture the shape of the loaded contact patch, which is then stitched together in CAD. In total, it can take a further 20 days’ work for one person to clean up the ▶

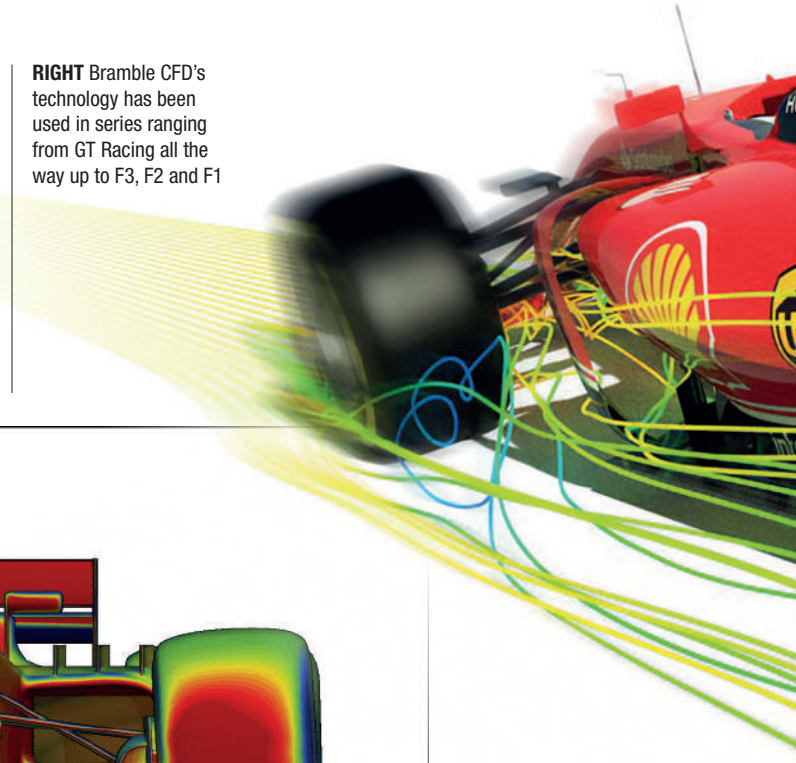
scanned geometry and combine it all into a useful model.

"You do need a good quality scan to get reliable results from the CFD. For instance, if you've got a rear wing with a main plane and a flap, you need to capture the detail in the slot gap between those two elements. So there's quite a lot of knowledge and experience in what makes a good scan, but it's a very useful thing to have," says Annetts.

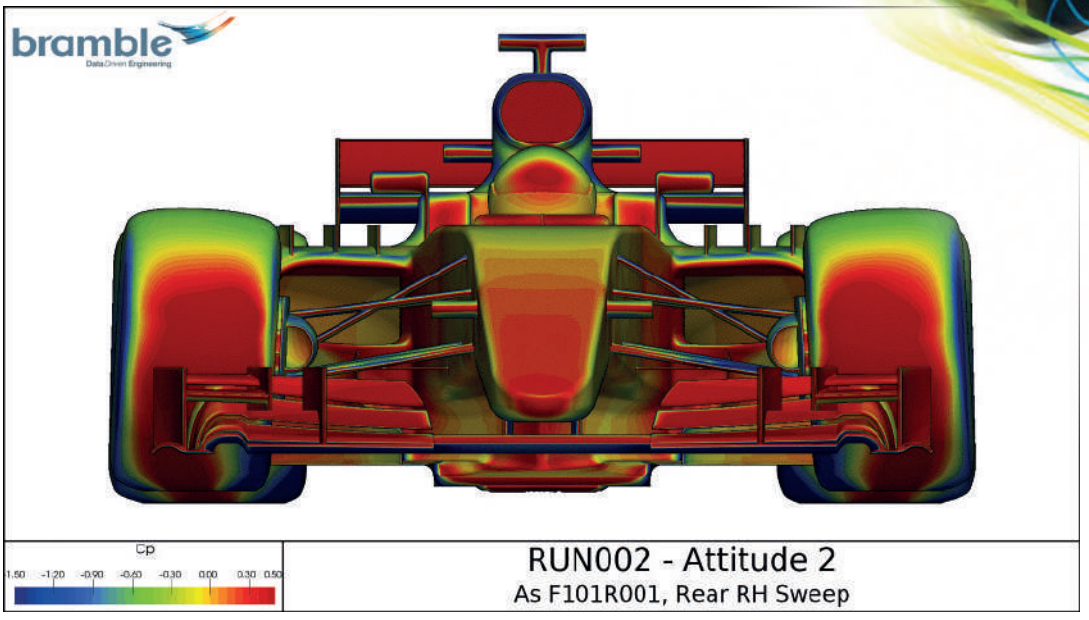
Once you've got a comprehensive CAD model, the real power comes from being able to manipulate it to test an almost limitless range of different scenarios – and that's where tools like Bramble come in. The software can be programmed to iterate through things like front and rear ride height, camber angle and vehicle yaw angle automatically, tailoring both the CAD geometry and the settings on the CFD model for each run. Bramble is said to do this in a matter of seconds, while updating the model manually could take a day's work and it can be a relatively error prone process when done by hand.

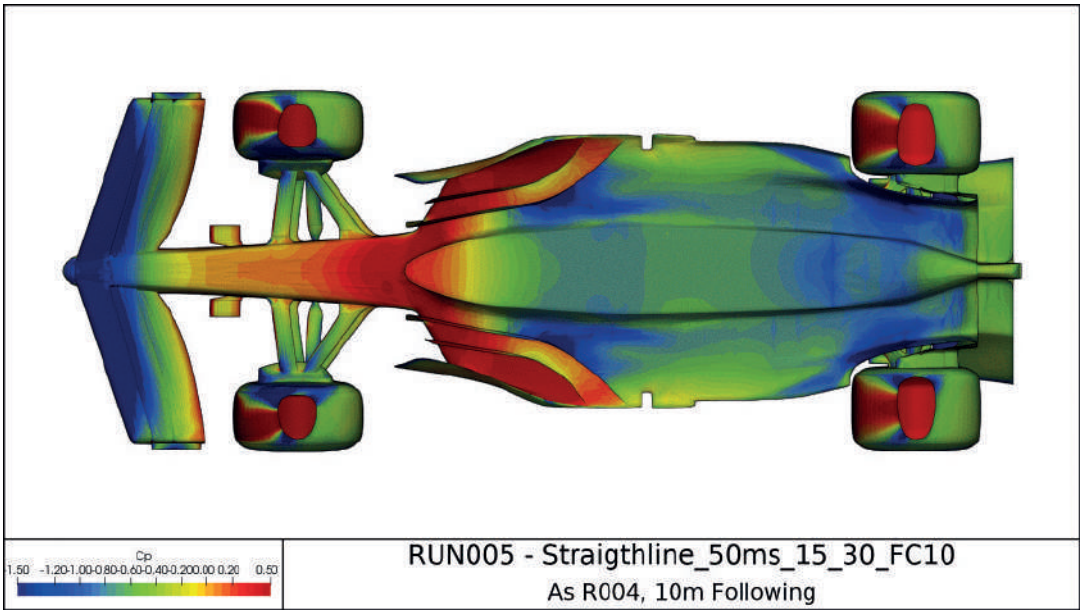
In reality, of course, no one has the resources to carry out an

> *"We could be on the verge of an even bigger change thanks to AI"*

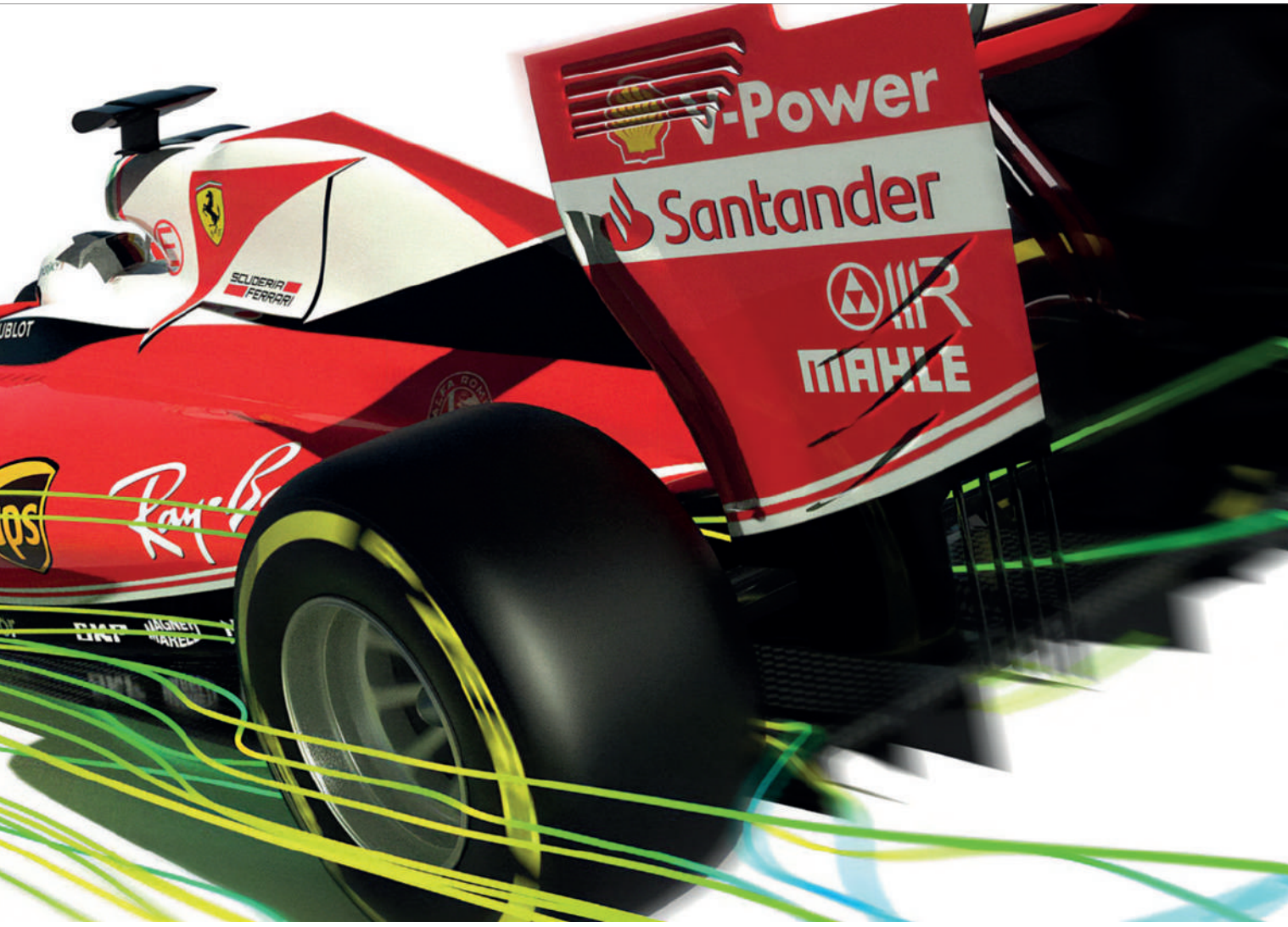


RIGHT Bramble CFD's technology has been used in series ranging from GT Racing all the way up to F3, F2 and F1





LEFT & BELOW
LEFT The FIA's aero team used Bramble to assess the drag and downforce of vehicle following vehicle in F1, with pre-processing only taking seconds rather than a day



infinite range of different simulations to cover every possible scenario. Even with the vastly improved capabilities of modern simulation tools, it still pays to work smarter as well as faster. Annetts points to the use of aero mapping data in lap simulations, where a traditional approach might be to run through a matrix of 10 x 10 (front and rear) ride heights, which requires 100 simulation runs.

"What you find is that there might be some areas of that map where the change in downforce with ride height might be quite small – and actually you don't need to run a simulation at every one of these data points. Or others where you know the performance has dropped right off and there's no point going any further. Conversely, there are some areas where the car can be very sensitive to small changes and you probably need more simulations," he explains.

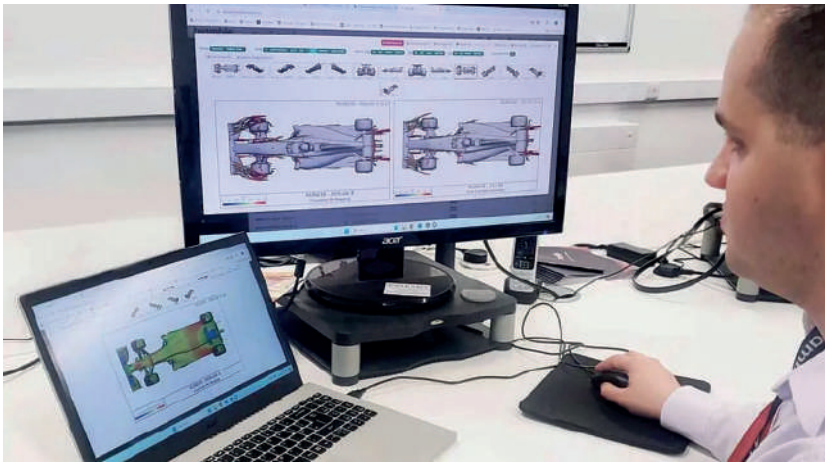
Bramble works with teams in a number of single seater categories, including Formula 2, Formula 3 and Super Formula as well as customer teams in GT racing, where the scope to make physical changes to the bodywork is relatively small, but the impact can be significant.

"We've worked with one team in a category where they were allowed to put shims on the front wing mountings. It was only three or four millimetres, but the feedback from the drivers was that it had a noticeable effect. Other examples we've seen include cars where you can tighten the floor stays to bend the floor up or down slightly," comments Annetts.

Perfect balance

Aerodynamic development is also important for teams and manufacturers working in performance balanced series, although the philosophy here has changed somewhat.

"The testing was very limited when the governing ▶



BELOW The quality of scanning is rising exponentially, leading to ever more detailed data for Bramble CFD's engineers to analyse

bodies first started applying BoP," comments Annetts. "The requirements would be set at one ride height, or perhaps a handful of ride heights, so once the car met the performance window for those conditions, there was sometimes a lot of benefit to be found by looking at cornering conditions, which is something that CFD can do very well. But I think that's changed.

> *"Having gone from days to hours with GPUs, we could be talking about seconds with AI"*

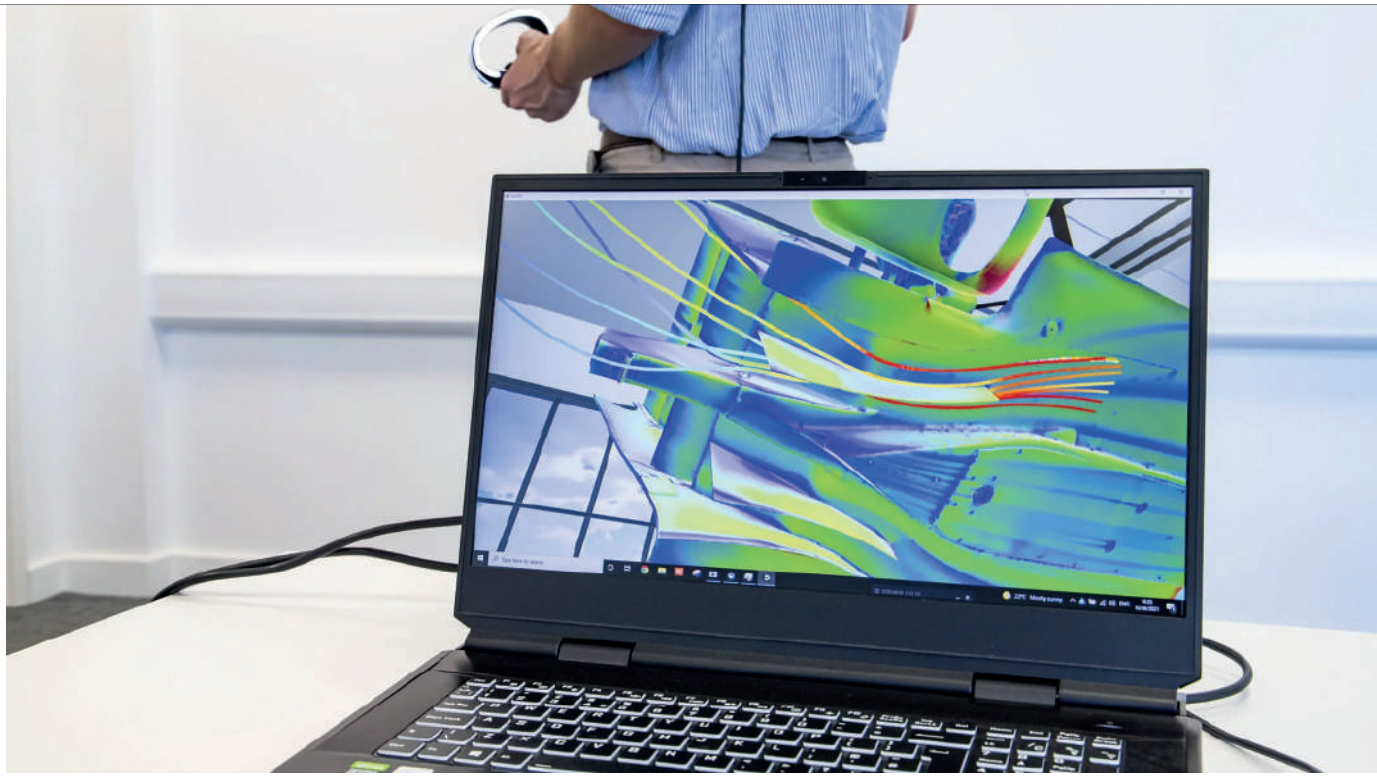
The governing bodies have become wise to those shenanigans, so they do a lot more multi-attitude testing. I'm not sure how much scope there is to find performance there any more, although people still do it, so I'd imagine there are still some gains to be had."

While BoP formulas restrict the car's outright aerodynamic performance, the aero package still has a major role to play in providing a stable and predictable platform – particularly in series like GT3 where the car has to be manageable for amateur drivers as well as pros. The emphasis here is on providing a high level of average downforce across the map and minimising balance change.

"Ultimately, the car is only as good as the performance that the driver can extract out of it," comments Annetts. "Many years ago in Formula 1, a lot of the teams found that they could get massive gains in wind tunnel performance by playing with the edge of the floor where it met the diffuser and the rear tyres. But when they got to the track, the performance would be the same or worse. That's because the gains they'd found were at very specific ride heights with wind tunnel tyres. As a result of that, the ethos changed to designing a floor shape that was relatively insensitive to tyre shape. That didn't deliver those peak gains, but it made the performance better overall, and I think that's a similar philosophy to designing a car for a BoP category."

BELOW The Artec Leo scanner provides an quick and agile way of capturing static objects. The in-built digital screen provides real time feedback to confirm areas are fully scanned, ensuring a complete and efficient process

BOTTOM On two wheels, the rider is a critical part of the scanning process. Here Rob White's riding position is painstakingly scanned on his innovative WMC250EV electric motorcycle to generate an ultra-realistic rider model



Intelligent approach

Faster processors and GPU-optimised codes mean that simulations that would have taken days can now be run in hours, with high-fidelity models tested over a wide range of different attitudes. But we could be on the verge of an even bigger change thanks to AI.

Broadly speaking, there are two camps when it comes to the use of AI in aerodynamics. Most of the work so far has focused on training machine learning algorithms to predict aerodynamic performance in specific scenarios that are closely related to existing data. For instance, if an algorithm is trained on a wide variety of single element wings, it can generally learn to predict the performance of another single element wing with a good degree of accuracy. Using an algorithm to predict values within the current range of known data points is known as interpolative machine learning, whereas extending beyond that range is known as extrapolative machine learning.

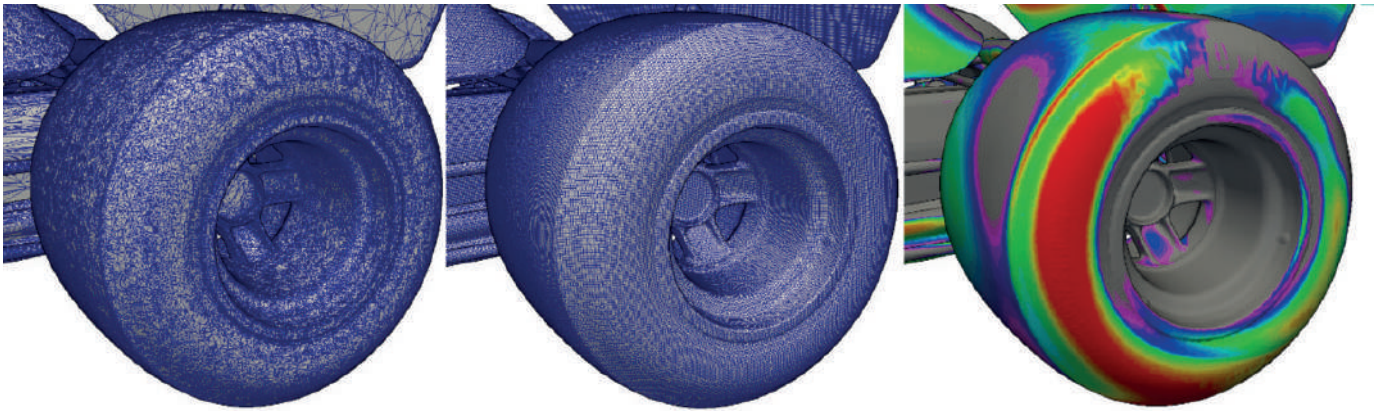
These types of models have already proved themselves to be a practical tool in aerodynamics, providing the right training data is available. Notably, Race Tech spoke to the FIA last year about a study that had been shown to predict the far-field wake from a Formula 1 car with astonishing accuracy, based on its near-field wake.

ABOVE Alongside the rapid improvements in technology for scanning and CFD, AI could streamline processes even further over the coming years

The next frontier is to push machine learning beyond these highly specific applications and towards a truly general purpose tool capable of predicting airflow in any scenario. These generalised models, sometimes called large physics models, could be applied to much the same tasks as today's CFD models. Most are still very much at the experimental stage, and it's not clear how long it might be until large physics models could become practical tools, but they have the potential to be hugely powerful.

"It's the generalised models that really excite me," comments Annetts. "Once we reach the point where it doesn't matter if you feed them a closed wheel car or an open wheel car, I think we could see another step change. Having gone from days to hours with GPUs, we could be talking about seconds with AI."

That's all speculative at present. What's clear, though, is that aerodynamics simulations will continue to evolve in the future, wherever the technology may go.



BELOW Establishing the precise relationship between the car and the tyres is critical when it comes to converting data into bona fide performance on the track

Chris Pickering speaks to Bosch Motorsport's Remi Fouret about the company's extensive involvement in the future of hydrogen power at Le Mans

WHAT LIES IN STORE?

BUILDING a car capable of running in the top category at Le Mans with a hydrogen combustion engine is perhaps the greatest challenge in modern motorsport. And yet the engine itself is only a relatively small part of that. In some respects, the bigger issues relate to storing and managing the hydrogen elsewhere on the car – and doing so in a way that is safe, practical and compact enough to fit in a top-tier racing car.

"I think we've started with the easy part," comments Rémi Fouret, head of Bosch Motorsport France. "Whether it's a fuel cell or a combustion engine, hydrogen powertrains are already out there. Of course, there are challenges for both, but you can see it already. We're working on a joint project with Ligier Automotive, for instance, where we've already done 6,000km of testing with a hydrogen combustion engine. So the reliability is there, and the performance is good. The challenge definitely comes with the storage."

Motorsport has 120 years of expertise with conventional fuels, but with hydrogen it faces a stark choice of handling a gas stored at hundreds of times atmospheric pressure or a cryogenic liquid that must be kept at -253 deg C. Even with liquid storage, other parts of the system will need to deal with gaseous hydrogen, which is such a tiny molecule that it's capable of permeating through some materials. In others it can cause embrittlement. It's also highly flammable and potentially explosive. These are challenges familiar to rocket scientists, but less so to car designers.

Nonetheless, the arguments in favour of hydrogen are compelling. It produces almost zero carbon emissions at the tailpipe; it avoids the weight penalty of battery electric propulsion; it refuels in moments; it requires less processing energy than e-fuels and it still delivers the drama of a combustion engine.

Hydrogen combustion is also an area where motorsport R&D could make a real difference to the wider world. The jury is still out as to whether hydrogen might be widely adopted for passenger cars but there are also applications in heavy duty automotive, shipping and aviation that could benefit.

So, despite the challenges around hydrogen motorsport, there's already a committed group of vehicle manufacturers, technology developers and suppliers investigating its potential. Among them is Bosch Motorsport, which is a technical partner of the ACO's MissionH24 initiative and Ligier's hydrogen-fuelled JS2 RH2 project, not to mention a supplier to virtually every team on the current Le Mans grid in one form or another.

Bosch recently unveiled its own Liquid Hydrogen Storage Control Unit, known as the L-HSCU. Fitted to the revised H24Evo demonstration vehicle, it's designed to control and monitor the entire hydrogen storage chain in the vehicle, from refuelling and storage in the tanks through to the point where it enters the engine or the fuel cell.

Liquid focus

While most of the hydrogen experiments in motorsport so far have used gaseous hydrogen, there is a definite shift towards liquid storage, led by the FIA's announcement last year that it would focus on this area.

One reason for this is storage capacity. Hydrogen's specific energy (per unit mass) is almost three times that of petrol, but its density as a gas is so low that even when compressed to 700 bar it would be challenging – perhaps impossible – to store enough on the car to supply a full-length stint at racing speeds.

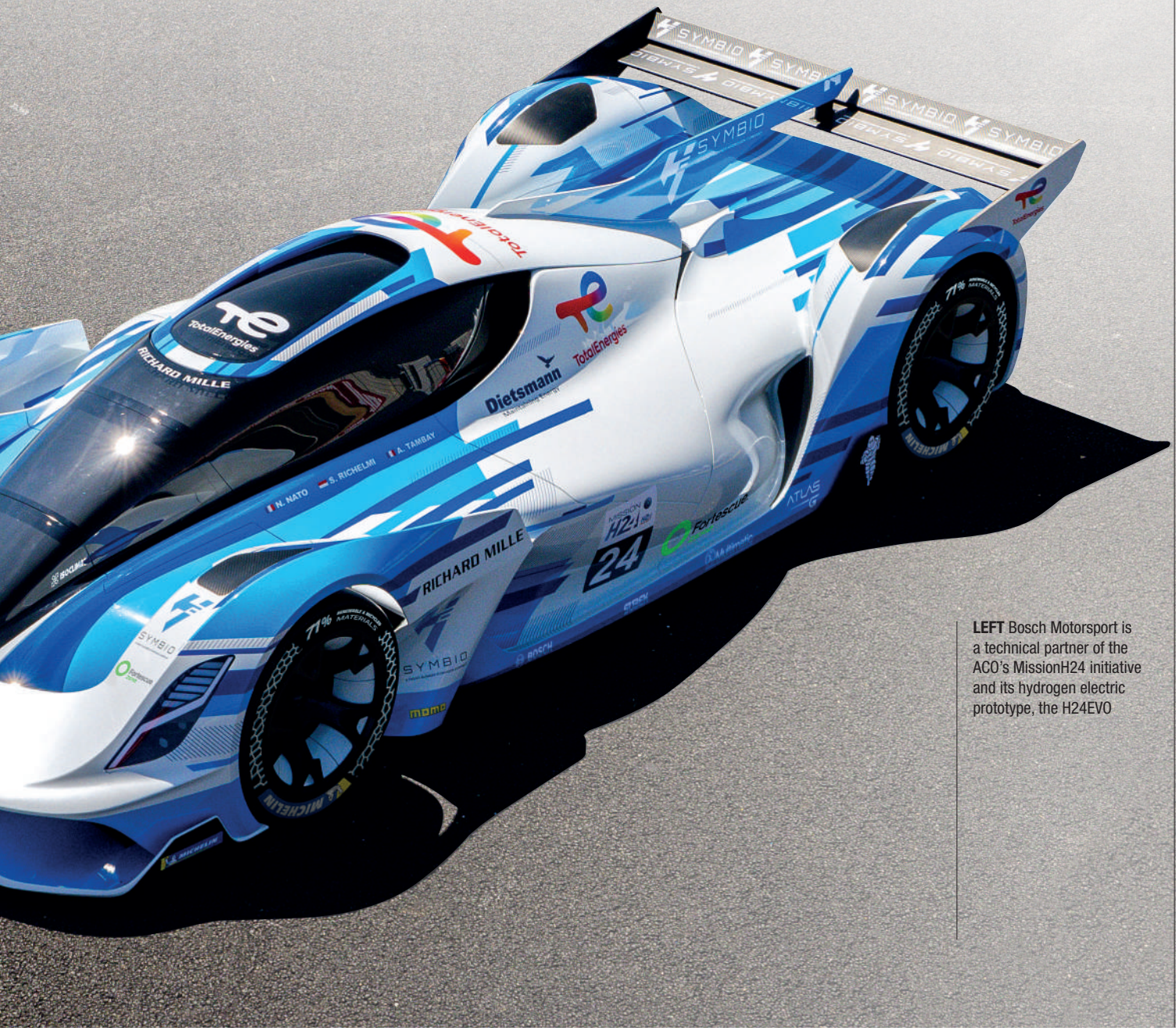
Roughly speaking, using liquid storage gives you 50 per cent more hydrogen in the same tank volume. It also opens up the option of using more complex, space-efficient shapes that wouldn't be possible with a highly pressurised vessel. It's likely that liquid storage would be a prerequisite if hydrogen cars are ever going to match LMH and LMDh pace over a full 24 hours.

> *"These are challenges familiar to rocket scientists, but less so to car designers"*

The safety benefits are equally compelling, as Fouret explains: "Storing liquid hydrogen at 3 bar dramatically reduces the risks compared to a high-pressure gas tank at 350 or 700 bar. By using liquid storage, you improve the safety, improve the range of the vehicle and improve the packaging options for the tanks."

Bosch, he points out, is technology agnostic and there are some use cases where gaseous storage makes more sense. Likewise, the company is supporting both combustion engine and fuel cell projects – the V6-powered Ligier JS2 RH2 and the fuel cell based H24EVO among them.

Fouret describes the L-HSCU as the "safety brain" of the car. Its roles include monitoring temperatures and pressures across the hydrogen system, sensing for leaks and responding to any issues. For ▶



LEFT Bosch Motorsport is a technical partner of the ACO's MissionH24 initiative and its hydrogen electric prototype, the H24EVO

instance, it has the authority to cut the engine or the fuel cell if it detects a problem. It also monitors boil off – the vaporisation of liquid hydrogen into a gas as it heats up.

"The FIA is currently writing a full protocol on how to use hydrogen in motorsport. At the moment, the target is to have tanks that use passive cooling. Heat soak into the tanks will cause some of the liquid hydrogen to become a gas. Up to a certain point that's okay – you'll always have some gaseous hydrogen in the tank – but this will cause the pressure to rise, and it can become a problem if the hydrogen boils off quicker than you can use it. We can simulate how long it's safe to leave the tanks without using the hydrogen and the target for a motorsport application is between 30 and 60 minutes, depending on the tank architecture," he explains.

The FIA has been looking at various scenarios relating to this. For instance, do the cars need to be fuelled on the grid to stay within that window before the start of the race? What happens if there is a full course yellow or a safety car and they don't consume as much fuel? What happens if the race is red flagged and they have to go back to the pits?

Part of the L-HSCU's job will be to control any boil off – either by venting the excess gas safely into an aftertreatment system or recirculating it back into the engine. However, the aim is to engineer the tanks so this won't be necessary.

"There's more and more simulation involved in motorsport, and simulating the tank state and the hydrogen state throughout the race is a new challenge. We've already adapted some of our CFD tools to work with gaseous hydrogen for the Ligier democar project, and now we're adapting them to liquid hydrogen," explains Fouret.

ABOVE The Bosch Motorsport L-HSCU liquid hydrogen storage control unit can be used to control and monitor the entire storage chain in the vehicle, from refuelling and storage in the tanks to the transfer to the fuel cell or the internal-combustion engine

"There's not much knowledge around liquid hydrogen in the automotive industry, so we've been in contact with aerospace companies as they're the main users of liquid hydrogen. But their use case is a little different to ours, so it requires some additional adaptation. With careful tuning, the industry standard 1D simulation tools can be adapted to work with hydrogen."

System architecture

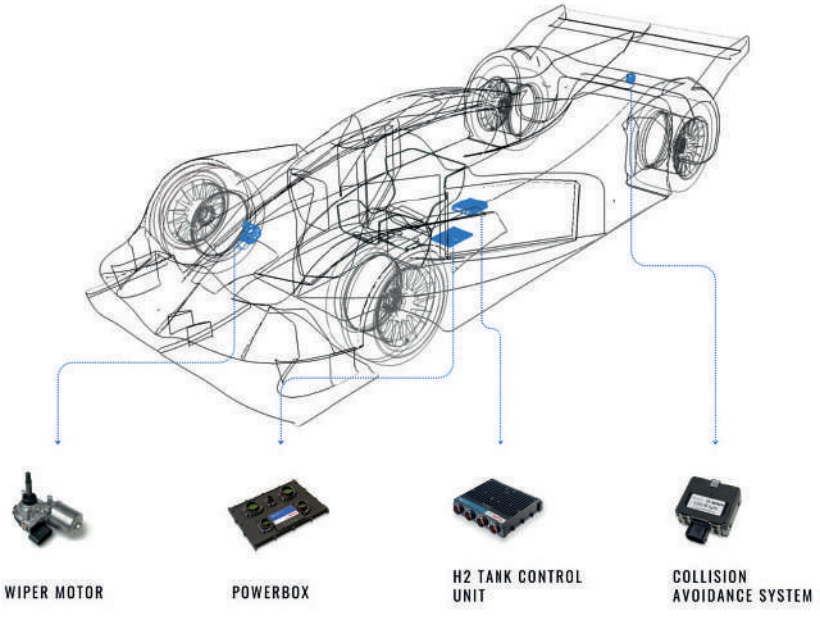
The layout of a hydrogen fuel system will depend largely on the pressure required to feed the powertrain. Fuel cells typically work at up to 15 bar, which can be achieved simply by heating the hydrogen as it leaves the tank and turns into a gas. In this scenario, it wouldn't be necessary to run a fuel pump as such – thermodynamics does the work for you. For a direct injection combustion engine, however, the hydrogen pressure needs to be raised to 40 to 60 bar, which requires a mechanical pump.

Bosch is investigating internal pumps that can operate within the tank immersed in liquid hydrogen, as well as external pumps working with the vaporised gas. Both are realistic options, but neither will be straightforward from a materials perspective.

"This is part of why we're interested in using motorsport as a laboratory," comments Fouret. "We have no boundaries in motorsport, so we can make it happen with any type of material as a starting point, then try to find more cost-effective alternatives as the second step. But in motorsport it's usually a lot easier to reach that starting point, working with prototypes.

"What we know already is that materials generally don't like big temperature

BELOW Components supplied by Bosch Motorsport for the H24EVO as part of the partnership with MissionH24 include the PowerBox PBX 190, an intelligent control and distribution unit for the onboard electric grid



MissionH24

ABOVE Bosch has adapted some of its CFD tools to work with gaseous hydrogen for the V6-powered Ligier JS2 RH2, shown here at Le Mans

changes. If you consider a standard petrol pump in a car, it could work from -30 deg C in Finland rising to +100 degrees in the engine bay. That's a big temperature delta. The target with liquid hydrogen is to find a material that can work at very, very low temperatures. Once you have that, the challenge isn't actually that big, because it's a very stable environment inside the tank at -253 deg C and 3 bar at pretty much all times, so you only really have to optimise for one point."

Once the hydrogen leaves the tank and begins to warm up it will vaporise almost immediately. One option the industry is looking into is a secondary tank to act as a buffer with a small quantity of gaseous hydrogen. This would ensure that there is always a ready supply of gas to cope with any transient demands from the combustion engine. Fuel cells, on the other hand, tend to operate at a more or less constant load.

> *"Liquid storage gives you 50 per cent more hydrogen in the same tank volume"*

For a combustion engine setup, it's likely that the fuel would be pumped out of the tank and into a heater to control its temperature before passing to a pressure regulator. Fouret envisions that this would generally be a two-stage system, with a passive mechanical regulator to protect from over pressures, followed by an active regulator to respond to the transient demands of the engine.

Infrastructure

The other major hurdle is getting the hydrogen to the car in the first place. Liquid hydrogen and gaseous hydrogen both present potential hazards, and opinions vary in different parts of the world as to which is the safer option. The logistical challenges also vary and, once again, neither is straightforward.

"Currently there is no regulation regarding liquid hydrogen filling stations at race tracks, which is a massive challenge – especially if you think about an event like the Le Mans 24 Hours, where you have fans everywhere," comments Fouret. "It raises questions like how big the safety perimeter would need to be if you had a massive storage tank in the pitlane. We need to answer these questions right now if we're going to make it a reality in the future."

The experience of those who've already experimented with this technology could prove vital, he notes: "When Toyota began running their Corolla with gaseous tanks they would do the refuelling very far away from the pit lane. But once they switched to a liquid they were able to refuel pretty much within the pit. In Europe high pressure gas is generally considered safer than liquid hydrogen. The Ligier democar was allowed to refuel in the middle of the ▶

Javier Jimenez/DPPI

crowd at Le Mans last year with gas, but there's a suggestion that a large liquid hydrogen tank would need to be placed in a remote and protected zone.

"So there is no international alignment on how to provide liquid hydrogen, to a truck or to a customer, and how to handle the crowd around it. It's not so much of a problem for a demonstration with one or two cars doing a couple of laps, but for real racing on many different tracks around the world, I think this will be the next big topic to tackle. Experts are working intensively on the topic and I am confident they will find a safe and suitable solution soon."

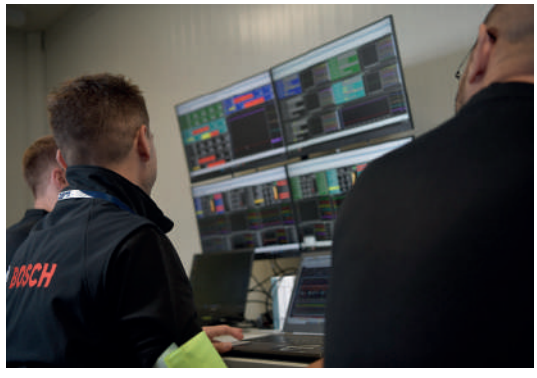
A field of truly competitive hydrogen cars – and the infrastructure to support them – could be motorsport's biggest technical achievement of recent years. It would certainly be a huge endeavour, and perhaps something of a gamble. But maybe that's what racing needs? A degree of mechanical jeopardy with manufacturers visibly pushing the boundaries on new technology.

"You certainly don't get technological breakthroughs of this magnitude every second year," comments Fouret. "In endurance racing we worked on large port-injection engines, then it was downsized GDI engines, now we're switching to sustainable fuels. I would say those were all part of natural evolution. Hydrogen really is a change of philosophy, and that's very exciting from an engineering perspective.

> *"This is part of why we're interested in using motorsport as a laboratory"*

ABOVE The H24 – the predecessor of the H24EVO – lapped the track ahead of the 2024 Le Mans 24 Hours

"The great thing about Mission H24 is that we have all the actors in this ecosystem gathered around ▶



RIGHT Bosch engineers pore over data in their WEC control room for the LMDh hybrid

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LEFT The ACO's MissionH24 initiative, of which Bosch is a technical partner, on show at the Hydrogen Parade at the 6 Hours of Spa-Francorchamps

the same table, including an energy supplier, tank supplier and a fuel cell supplier. We have to work together to make it happen otherwise we'll never find the right compromises. For us, Mission H24 is the chance to work together with that whole ecosystem."

Switching to hydrogen might just be the biggest technical shift in a generation, but there have been others.

"Every time we take a technological step, there is a learning curve. In endurance racing and other motorsport series, the latest major step has been the hybrid systems – and we've seen some failures of these systems in races. I think there would be a steep learning curve on hydrogen as well," comments Fouret.

"The main thing is that we have to make sure that it will always be done in in a safe environment, even if there are failures. That's something that endurance racing has done very well with hybrids. We've not seen any battery fires or people getting electrocuted by the high voltage systems. Of course, there have been failures because motorsport is about getting the best out of the car, but they haven't compromised safety. I think we need to take the same path with hydrogen. At the end of the day, motorsport is a demonstration for new technology. We have to be a role model and we need to make sure that we don't kill the technology with a problem on track."

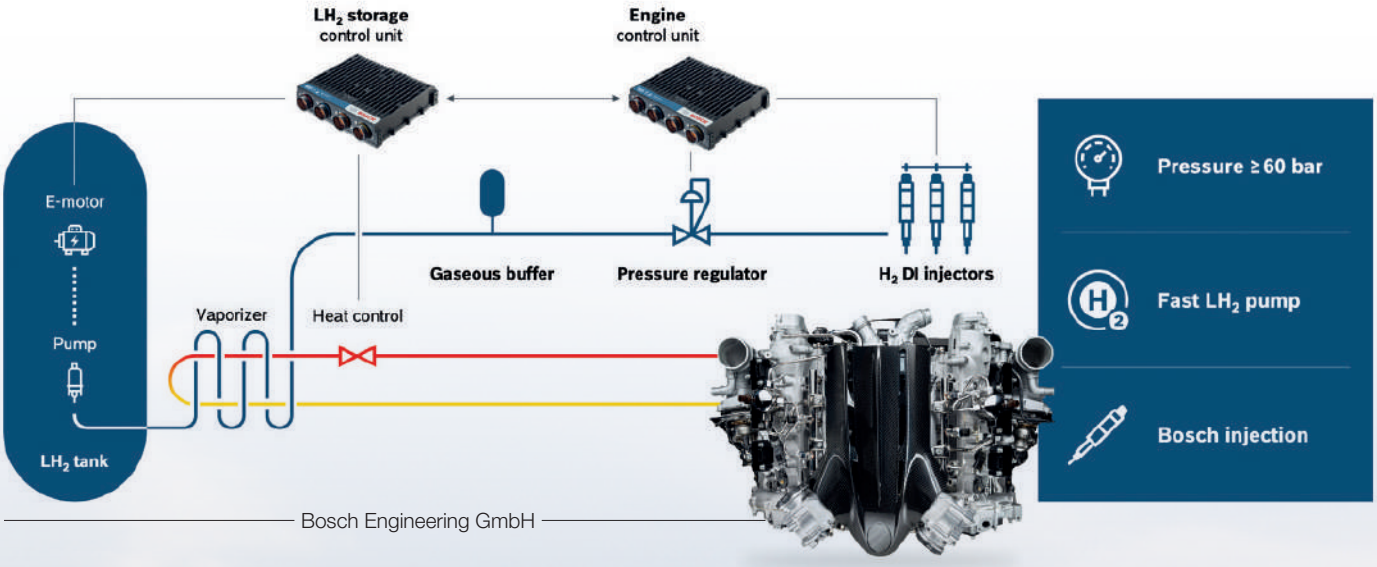
Of course, the question of where hydrogen technology might actually migrate from motorsport remains. Toyota is still investing heavily in fuel cells for mass market road cars, as are Honda and Hyundai. Elsewhere, many seem to be leaning in favour of battery electric vehicles or sustainable fuels for traditional powertrains, but it's by no means a foregone conclusion.

> *"You don't get technological breakthroughs of this magnitude every second year"*

"We're working on the emissions aspect of hydrogen combustion – not because of motorsport, but because we believe it could be road relevant," comments Fouret. "Mass production manufacturers will take the option that proves to be most reliable and most cost effective, but you have to think about the small OEMs selling sports cars. They have to think now

BELOW The H24EVO prototype will store liquid hydrogen on board thanks to the L-HSCU developed by Bosch Motorsport

Mission H24



about how they deliver passion and excitement to their customers with a climate-neutral powertrain in 10 or 20 years' time. Do they go completely electric? I think there's a real chance for the combustion engine there. Perhaps not for the mass market, but at least for some road cars. On top of that we have applications like trucks. Hydrogen for truck racing is on the table, because it could be a very road-relevant technology for that too."

While a lot of unanswered questions remain, impressive strides have already been taken in hydrogen motorsport – notably by Toyota, with the production-based Corolla that has used liquid storage in the Fuji 24 Hours in Japan. But if the technology is going to generate mainstream publicity it needs a global platform. A car that can take on the frontrunners, competing for victory in a major international race. If that happens, it's highly likely to be at Le Mans. And Bosch is sure to be involved. RT

ABOVE Bosch has developed the concept for hydrogen engine and tank systems, including adjustments to the ignition and injection systems

BALANCE OF POWER

Gary Watkins reveals what we learned from Le Mans 2025 – from Toyota's hydrogen ambitions to Hypercars, LMP2 and more

A glimpse of the future was offered during Le Mans 24 Hours week in June. And at the same time the opposite happened: the present was prolonged.

Toyota took the wraps off a soon-to-be-running development car that represents tangible progress towards the fulfilment of its dream to put a hydrogen-fuelled car on the grid at the French enduro. How its ambitions and those of the Automobile Club de l'Ouest to introduce the alternative fuel in liquid form to the pinnacle of sportscar racing fit with the extension of the current Hypercar category announced until the end of 2032 isn't entirely clear.

A firm start date for hydrogen was the one thing missing when a road map for the future of top-line sportscar racing was laid out in a series of announcements at Le Mans. Included among them was the unveiling of the constructors who will be licensed to produce the new generation of LMP2 contender, and the identity of the sole engine supplier that will power them.

The unveiling of the Toyota GR LH2 Racing Concept hybrid prototype in the ACO's H2 Village, an area packed full of projects showcasing hydrogen technology, is an important development. It came two years after it formally announced its ambitions to race an internal combustion engine prototype fuelled by hydrogen at the same time as revealing another 'Racing Concept', the GT H2. This was nothing more than a clay model, a styling exercise to draw attention to its vision.

Since then Toyota has pushed on with developing hydrogen technology in the line of Corolla touring cars in the domestic Super Taikyu Series in Japan since 2021. The latest of those – the Corolla GR H2 – became the first race car fuelled by liquid hydrogen when two years later it contested the blue riband round of the series, the Fuji 24 Hours. As for its ambitions to compete in a rather more important 24-hour event, it has been playing a waiting game.

It nailed its colours to the mast in June last year when the opening up of the rules for hydrogen technology at Le Mans was pushed back for a third time to 2028. But uncertainty remained about the project for a simple reason. There were no rules, a state of affairs that remains the case 12 months on. The line from Toyota Gazoo Racing Europe in Cologne has been that it can be ready for 2028, but that it needs the regulations soon.

The first step on that road was the formulation of what FIA chief technical and safety officer Xavier Mestelan Pinon calls "the generic regulations for liquid hydrogen": the governing body chose liquid over gaseous hydrogen for motorsport applications in February 2024. These protocols were signed off by the FIA World Motor Sport Council held in Macau in June and will shortly be added to Appendix J of the International Sporting Code. They include strict standards for vehicle integration, storage systems and refuelling procedures, as well as key safety measures including pressure-tested tanks and leak detection.

What we know about GR LH2

Number one. It is a 'real' car destined for the race track, unlike the GR H2 concept. But beyond that Toyota is playing its cards close to its chest for the moment.

The car is based around its current GR010 HYBRID Le Mans Hypercar and it has been built in Cologne. What has not yet been disclosed are any details of the hybrid powertrain, though like those of the GR010 they have been developed at the manufacturer's Higashi-Fuji Technical Center in Japan.

The idea behind the GR LH2 is to get a proper hydrogen prototype up and running to continue learning lessons about the fuel that cannot be garnered from going racing with production-based machinery. ▶

Toyota GAZOO Racing

ABOVE Toyota's GR LH2, based on its current GR010 HYBRID Le Mans Hypercar, is at the vanguard of the hydrogen revolution

No timeline has been laid down for the first track runs of the car, though it "is not far away," says Kazuki Nakajima, who took up the chairmanship of TGR-E on his retirement from the cockpit in 2021.

"Our main target right now is to expand the possibilities of hydrogen combustion engine technology," he explains. "Our intent is to test the car – not only the combustion engine – to learn a lot about the infrastructure and fuelling system. There is more to come and to get to the right level we need to improve the technology further."

To that end Toyota has linked up with the MissionH24 group, in which the ACO is a stakeholder, to work on the development of hydrogen. It was announced at the ACO's Friday press conference as a "strategic partner" in a venture established back in 2018 and now on its third (though yet-to-run) hydrogen fuel cell development car, the H24EVO.

> *"Toyota can be ready for 2028, but it needs the regulations soon"*

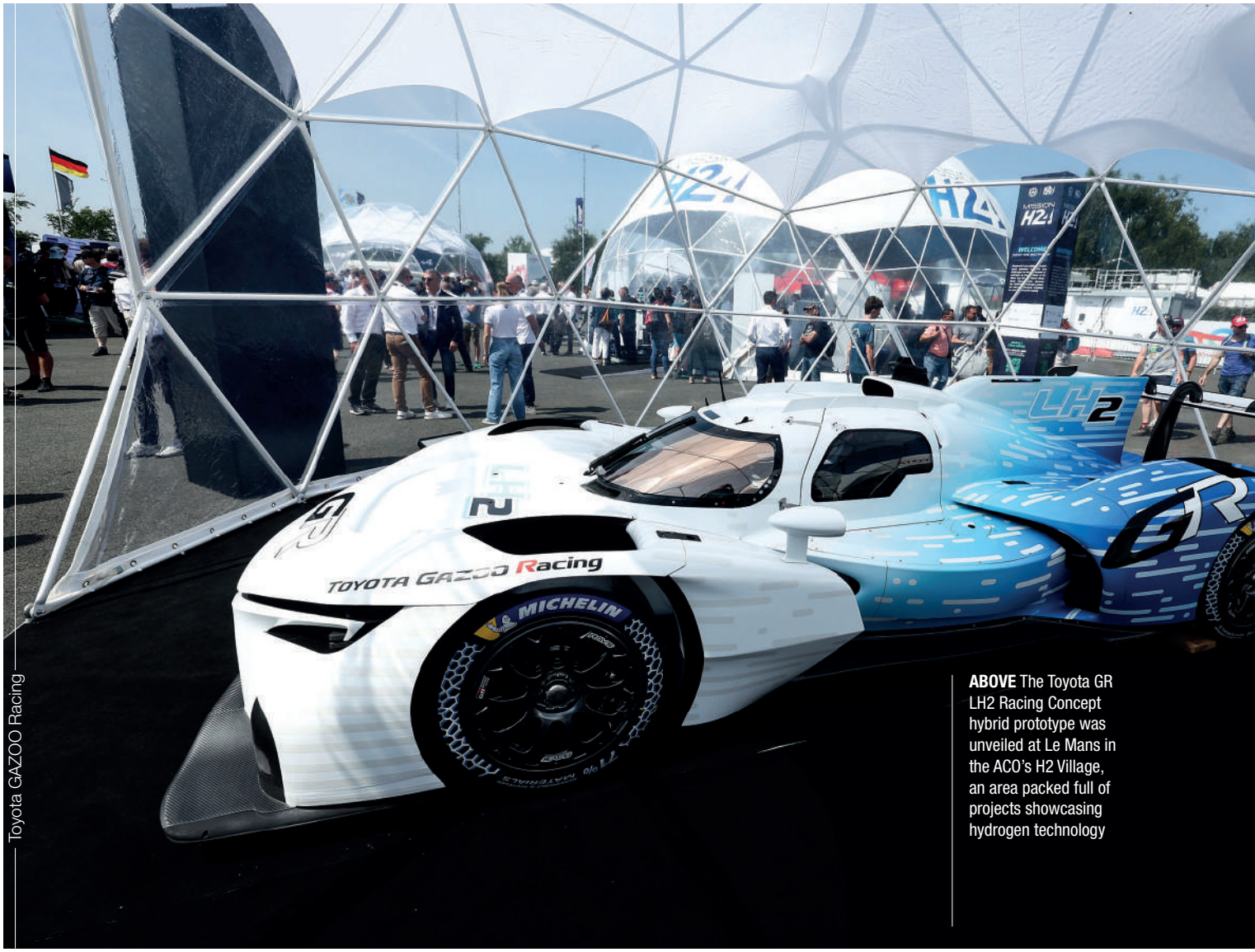
"We will support the strengthening of the MissionH24 project by utilising the know-how we have gained in developing hydrogen technology through motorsport," says Nakajima. "The ACO is a pioneer of hydrogen in motorsport, and we empathise with its strong commitment." The focus will be on working together on aerodynamics and cooling, according to a statement from MissionH24.

Hypercar extension

At the same press conference the life of the Hypercar category was extended through to the end of 2032. Expected as this was, it is a significant move – given the announcement at the corresponding event in 2024 that LMH and LMDh machinery were being given an extra two years.

Prolonging two rule sets that have breathed new life into the top echelons of both the WEC and the IMSA SportsCar Championship is an obvious step. There are now eight manufacturers represented in Hypercar in the WEC, three more about to join in 2026 or 2027, and a further two marques that compete only in North America.

"It is important to give the manufacturers and the audience a signal of stability as



Toyota GAZOO Racing

ABOVE The Toyota GR LH2 Racing Concept hybrid prototype was unveiled at Le Mans in the ACO's H2 Village, an area packed full of projects showcasing hydrogen technology

Charles Guenant – Alcyon Media Groupe

RIGHT The ACO outlined its goal to bring hydrogen to Le Mans way back in 2018 but factors such as refuelling times will be critical

BELOW RIGHT Toyota GAZOO Racing's Europe Vice-President Kazuki Nakajima addressed the press at Le Mans alongside ACO President Pierre Fillon

Javier Jimenez/DPPI

we need to show that this platform is sustainable and strong," says ACO president Pierre Fillon, the key driver of the hydrogen crusade along with Toyota chairman Akio Toyoda. "We are guided by two principles, stability and cost control, which is why – together with the FIA – we have decided to extend the rules until the end of 2032. Giving the manufacturers a chance to get a return on their investment was the target for us."

The move means the LMH will end up having a 12-year life, LMDh 10 years. LMH came on stream in 2021 in the WEC, with the original five-year cycle extended to seven years to bring it into line with LMDh on its arrival in 2023. If and how the rules will evolve between the 2029 end date announced last year and 2032 isn't clear. What Fillon described as "the practicalities" of the extension still need to be worked out. Mestelan Pinon added: "Maybe we will revise the current regulations, but what we are saying is stability."

IMSA has yet to follow the WEC's lead by confirming an extension of the rules for what it calls the GTP class. But series president John Doonan has dropped heavy hints that IMSA will remain aligned with the WEC. He said there is "hope to also to carry on the top category regulations to 2032", adding that there will be "more definition" to come. At the same time it announced that it has signed an extension of what is dubbed its "strategic alliance" with the ACO until 2032.

The link-up effectively goes back more than a quarter of a century, since the late Don Panoz forged ties with the ACO on his takeover of the IMSA-run Professional Sportscar Racing Championship Series in 1998. It led to the creation of the American Le Mans Series the following year and continued after the merger of the ALMS by the France family for the 2014 season.

"The undeniable success that endurance sports car racing is currently experiencing all over the world is directly the result of the ongoing partnership between IMSA and the ACO," says Doonan. "Together, we created technical platforms and regulations that have attracted an unprecedented number of manufacturers by ensuring relevance and budget practicality."

Where does this leave hydrogen?

Last year, the ACO and the FIA outlined a vision whereby the first hydrogen cars would arrive on the grid at Le Mans and for selected WEC races – one before and one after the 24 Hours was the aim – in 2028 before being able to compete for overall victory in 2030 on the introduction of whatever is to follow LMH and LMDh.

It is still saying that hydrogen, whether powering an internal combustion engine or a fuel cell, will be battling at the very front. This is a key tenet of its hydrogen strategy given the costs involved. "There is no interest for the manufacturers to come in a ▶

hydrogen category," Fillon said last year.

But the ACO and the FIA, which jointly run the WEC, aren't talking dates at the moment, perhaps not surprisingly. The ACO outlined its goal to bring hydrogen to Le Mans way back in 2018 and subsequently set a target date of 2024 for what was originally going to be a formula demanding a one-make chassis developed by ORECA and Red Bull Advanced Technologies. Last year's delay until 2028 was the third postponement.

"Today we are not announcing anything in terms of timing," said Mestelan Pinon. "When a manufacturer and the ACO/FIA can be ready, it is too early to say. You have to understand how big the challenge is: you have the cars, but you are also talking about refuelling, the infrastructure, the marshalling systems. You can imagine the number of challenges we are facing. Please give us time, and the same for the manufacturers."

Nakajima also backed away from mention of a Toyota 2028 Le Mans campaign with hydrogen. "You need to be careful when talking about our intent," he says. "At the moment our intent is to test the GR LH2."

It seems likely, however that hydrogen's introduction will be pushed back. "I do not know today whether it is 2029 or 2030 to have current Hypercar plus hydrogen," says Mestelan Pinon. But the ACO and the FIA believe it is realistic to have hydrogen cars competing on equal terms with conventional Hypercar machinery from the get-go.

"Hydrogen is making big steps every year," says ACO technical director Thierry Bouvet. "For sure the development rate is big." Mestelan Pinon added that he believes that achieving lap time parity will be relatively straightforward, though he conceded there will be "some challenges in terms of weight" while the bigger challenge will be "equalising the refuelling time". Or rather bringing the time it takes to refuel a liquid hydrogen prototype in line with that of a Hypercar.

> *"It is realistic to have hydrogen cars competing on equal terms with Hypercar machinery"*

ABOVE Gibson Technology will continue to supply the one-make LMP2 engine, ORECA and Ligier the chassis

The ACO and the FIA are still saying that they want both hydrogen-fuelled cars with internal combustion engines and fuel cells to compete together. They don't want to tell a manufacturer which route to take and insist both will have an equal chance. "It is not for us to decide," says Bouvet. "The ACO has always said that both will be allowed."

That's not quite right. It was only talking about fuel cells until 2023. That was when it opened up to combustion technology as a direct result of Toyota's interest.

BELOW IMSA's LMDh platform – pictured at Watkins Glen – marks a success story of the convergence between WEC and IMSA

LAT USA

What about LMP2?

The ACO and the FIA have also changed tack on LMP2. A year ago they announced they were scrapping the planned replacement for the current formula introduced in 2017 and that they would be starting all over. That made sense given the number of extensions for a set of regulations that originally had a four-season life through to the end of 2020. The next-generation of P2 chassis, which provides the spine for all the LMDh contenders competing in WEC and IMSA, was set for a 2024 introduction before being delayed until 2026. Last year's announcement of an intent to start afresh coincided with a further two-season extension of the existing rules before the arrival of new cars in 2028.

The ACO and FIA made clear in June 2024 a desire to switch to a smaller-capacity turbocharged engine from the normally-aspirated V8 concept. Gibson Technology has supplied the one-make P2 engine, the 4.2-litre GK458, since 2017, and also won the tender to continue that arrangement when the next-gen cars were meant to arrive in 2026. ▶

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LEFT & BELOW
LEFT As AF Corse's privately-run Hypercar took the overall spoils at Le Mans, the ACO announced the current Hypercar category would be extended until the end of 2032

HYPERCAR HOMOLOGATION CYCLE EXTENDED UNTIL 2032

The other big change became apparent in March when the FIA put out its invites for tenders. Only two chassis manufacturers would be given licences rather than the four of 2017 and the unseen next-gen cars. The original chosen pack of ORECA Motorsport, Ligier Automotive, Dallara Automobili and Multimatic Motorsports all had their agreements reconfirmed on the unveiling of LMDh in January 2020, the historic convergence announcement before that year's Daytona 24 Hours IMSA season-opener.

Awarding four licences again was never on the cards, explains Mestelan Pinon. Rather the internal discussions at the FIA and the ACO were "more between one and two". P2 has become a de facto one-make series for the ORECA 07 chassis – the Paul Ricard-based organisation hit 100 examples built as long ago as 2022 – but the stakeholders in the category wanted it to retain competition between marques.

"What is important for us is to offer a choice to our competitors and, because of the choice, we are able to offer the best technology," says Mestelan Pinon. "We hope it will improve the category."

Avoiding market dominance

P2 is a Balance of Performance category, and has been since 2011 on the introduction of a new set of rules incorporating a cost-cap for the first time and strict controls on development. Since then there has been only one example of the BoP being invoked, though the ACO and the FIA announced plans for a new system dubbed Adjustment of Performance for the still-born next-gen cars in 2022.

Back then, the ACO stated it wanted to "protect the market position" of the four licensees with the AoP. The FIA now admits doing that is easier with

Julien Delfosse/DPPI

two rather than four constructors. The message seems clear: the BoP will be used when the new cars arrive in 2028 to avoid the market dominance ORECA has enjoyed.

Two of the gang of four did not enter the race, Multimatic and Dallara choosing against trying to establish the kind of foothold in the market to which they never appeared committed under the 2017 rules. The tenders have been won by ORECA and Ligier, it was announced in Le Mans. There were others in the mix, however. Relaunched Lola Cars, a player in the P2 market through the 2000s and into the 2010s in its previous incarnation, also entered the fray.

Gibson has again been successful in bidding for the engine licence, with a new powerplant to replace the GK428. It will be a twin-turbo V6 with direct injection, though the ACO/FIA has so far chosen not to announce further details.

The chassis tender called for a minimum weight of 980kg for the complete car and the engine tender for maximum power of 420kW (560bhp). Those figures are not so far away from those at which P2 machinery races at Le Mans: since the category disappeared from the WEC last year the ORECA-Gibsons compete in down-specced form when they rejoin the series on a one-off basis each year. The cars weigh at 950kg and have 540bhp, which compares with 930kg and 580bhp in the European Le Mans Series.

Mestelan Pinon insists the FIA/ACO are aiming for similar performance levels to the current P2 and that the new cars will slot into the WEC grid at Le Mans neatly between the Hypercar class contenders and the LMGT3 machinery that has been part of the grid since 2023.

There is the provision to slow them, however. The engine tender document states that the 420kW max power will be "adjustable to 380kW". That's just 520bhp. That could be an anticipation of the need to maintain what is known as class stratification on the belated arrival of hydrogen cars. The timing of that and how fast they can lap are the two pieces missing from the prototype jigsaw laid out on the table at Le Mans this year.

ABOVE Allowing the new wave of Hypercar entrants time to justify their investment was a key factor in the decision to extend the current regulations. McLaren (pictured), Ford and Genesis all made announcements at Le Mans

ONWARDS & UPWARDS

Ford's Super Mustang Mach-E electric prototype made its debut at Pikes Peak in June. **Hal Ridge** discovers how it went – and why it could yet come back

MUCH like when Volvo shocked the establishment by running its 850 Estate in the British Touring Car Championship in 1994, Ford Performance's effort at the 2023 Pikes Peak International Hill Climb with the latest iteration of its SuperVan (4.2), based on a Transit, could only have continued had it been as successful as it was wackily marketable.

Even if the SuperVan's life was limited – as is so often the case in motor racing, especially with key-pillar events such as the Dakar Rally, Le Mans 24 Hours and Pikes Peak – Ford grew an affection for the famous Colorado ascent in that outing with its unusual electric machine.

As such, SuperVan – which did break the Open Class record – made way for the F-150 Lightning SuperTruck last year for Ford's return. This claimed victory and the King of the Mountain title, despite a technical hitch en route. But, with thirst for taking on the 12.42-mile route still unquenched, and a hunger to challenge for further outright wins and even record-breaking times, Ford, together with technical partner STARD, hatched a plan for an all-new machine for its third straight 'Electric

> *"The Super Mustang Mach-E is a clean-sheet design from a chassis perspective"*

Demonstrator' Pikes Peak effort.

SuperTruck had been an evolution of SuperVan but the Super Mustang Mach-E is a clean-sheet design from a chassis perspective, while the powertrain has also been freshly developed for its 2025 campaign.

Given the green light at the start of November 2024, like its predecessors the Super Mustang Mach-E chassis is of tubular spaceframe construction. But this time the specific model used was guided as much as by what the engineers thought would be most efficient, as what the marketing department wanted to showcase.

"Once we finished SuperTruck, we started looking at how we could come back more competitive. What would it take? It was a full ground-up redesign: through simulations we calculated vehicle width, length and height, overall aerodynamics, powertrain configuration and how the suspension should work. Then we decided what that would look like vehicle-wise, making sure we stay within the Ford production silhouette and figure out which vehicle best represented that," explains Zach Burns, Ford Performance EV Program Engineer. "So it made sense to use a Mach-E."

The complete package

Having worked out the vehicle's external physical parameters and selected a model, the next priority was packaging STARD's three-motor powertrain, a concept initially conceived for its ERX rallycross programme but now much evolved. This was a challenge met head-on while also dealing with an aggressive aerodynamics concept.

"Keeping a carryover battery and battery case, there's a hump in the middle and to design around ▶

BELOW Ford's Super Mustang Mach-E demonstrator was purpose-built to tackle the gruelling Pikes Peak course

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that was kind of challenging. We had to take Romain Dumas to the studio up in Dearborn [Ford's Michigan world headquarters] with VR goggles, like an AR experience. We put him in a race seat and moved it into different orientations to where we thought it might work and how it would feel in the vehicle. We had to do a lot of playing around with that just to make sure the packaging around him made sense."

Dumas' experience as a five-time Pikes Peak winner also proved vital in that calibration of the chassis' intrinsic makeup, with input as seemingly

> *"We had to take Romain Dumas to the studio up in Dearborn with VR goggles"*

obvious but easily overlooked as the requirements of the different sections of the course.

"You're racing uphill, right? So you're not just looking out of the front windscreen. Instead you're looking up out of the top of your windscreen – all while doing a lot of hairpins," notes Burns. "It's also about how much you can see out of the side. High visibility is very beneficial. So the whole front of the car is very clear and easy to see out of – so you can hit the apexes as well as you can."

The Super Mustang Mach-E boasts 3.1 tonnes of downforce at 150mph at sea level, the result of a big push in the programme to make the car as aerodynamically efficient as possible. The benefits of decreasing drag include increased range and battery performance in the electric powertrain. That gives it an advantage over its internal combustion powered rivals, especially when air density decreases with elevation and the air-breathing engines experience inevitable power loss.

Yet due to timescale, the car has never seen a wind tunnel. Once the programme got its green light at the start of November, huge effort was put in before a design freeze in mid-January (pushed back from an originally-intended date even earlier in January) for the chassis and aerodynamic design concepts to work in harmony.

"I wish it was easy enough to say the chassis was designed and then we did aero around it. But the project design was moving ever so quickly; the chassis was being designed while suspension was being designed while the aero was being done. So every single component was being moved around so it was a case of: here's the box that we want you to stay within, please stay here," says Burns.

"At the back end, we had to package the inverter right above the motor because there's no space. Then you put the rear shocks in a certain spot, but they are in the way because now you want the huge diffuser. So it's all a big balancing act of making sure we got the right kinematics on the suspension side, while also leaving enough volume and space for the aerodynamics group to design the best possible package they could as well. It was just an overall fluid movement."

It clearly worked, with figures suggesting the car has more downforce than a current LMDh machine. It also weighs in at 1521kg – over 100kg less than SuperTruck.

RIGHT The Race to the Clouds offers stunning scenery every step of the way

BELOW At the heart of the Super Mustang Mach-E demonstrator are three STARD UHP 6-Phase motors producing over 1,400bhp

While time wasn't available to validate the CFD in the wind tunnel, the resources of the automotive giant do come into their own in such unique projects as these. For more privately run efforts, elements like creating the bodywork would be a hugely time-consuming and expensive process, but this is where Ford is able to flex its muscles. In the firm's European-based 3D printing and rapid prototype manufacturing facility, every mould for the Mach-E's panels was produced.

"They're legends for being able to just fit us in when they could," says Burns. "We have a lot of 3D ▶

ABOVE The Pikes Peak dashboard has to take into account the fact that drivers spend most of their time looking up

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printing capabilities elsewhere too, in the UK and in Dearborn. It's a huge effort, not only internally but externally in Ford, with all of our different resources to help build this vehicle."

Power up

As an external technical partner but intrinsically involved in the Pikes Peak effort, Austrian firm Stohl Advanced Research and Development (STARD) carried over its powertrain for the car, including its 50kWh battery constructed of Li-polymer NMC pouch cells. It reduced each of the three 6-phase motors' weight – two in the rear and one in the front of the four-wheel-drive machine – by almost four kilograms each. But it was in the control system where most gains were made, as the resulting vital statistics show: operating at 799V and producing the equivalent of 1421bhp.

> *"We're only running 12 miles so we just need the most grip we can possibly get"*

"The battery and the inverter are carryover, just saving costs, but we did bring in ABS to help with ▶

RIGHT A third damper was added both front and rear to control the aero platform

BELOW The car's carbon braking system, forged magnesium wheels and Pirelli P-Zero tyres are engineered to withstand the event's punishing 156 turns

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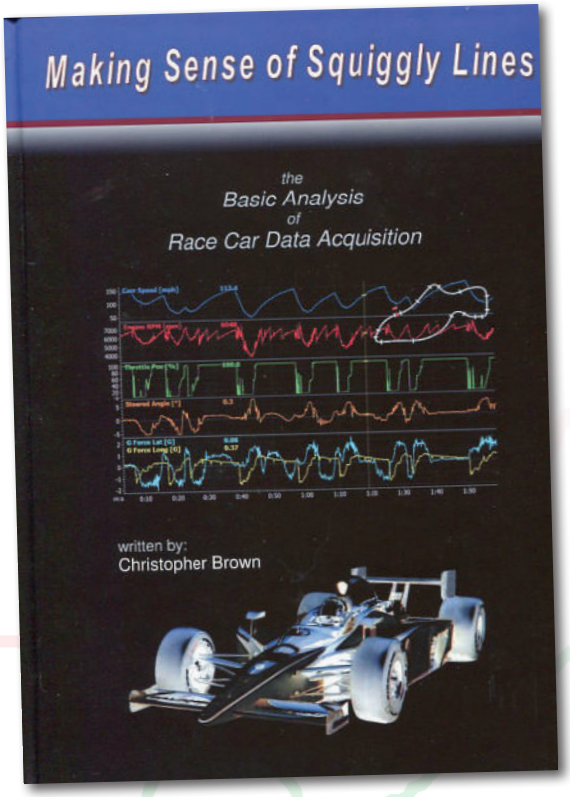

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the braking [together with carbon brakes as opposed to the carbon ceramic used on the SuperTruck], a new traction control system, grip limit system and how we do torque vectoring," says Burns.

At each corner, a collaboration with AP Racing has brought the braking potential of the car forward. The calipers are very similar to those used in LMDh but the pads and discs are designed to work from a lower start temperature, to ensure they are in the operating window at the start of the run.

The brakes are shrouded by forged magnesium wheels, clad with Pirelli P-Zero tyres. Fundamentally, it's the same rubber as used on the rear of a GT3 car, but on all four corners. Yet where the Italian firm has worked hard is in developing the rubber to work better, for a shorter period.

"We're only running 12 miles not endurance laps, so we just need the most grip we can possibly get," says Burns. "We get recommendations on tyre temps [inside the tyre blankets pre-run] plus how long we need to ramp up the heat and what pressures to run – based on predictions for the start of the run versus the end and where we want to be in the pressure window."

> *"It was a bummer that we couldn't run the whole mountain to prove the vehicle's capabilities"*

The key to putting the electric powertrain performance to the ground in this latest hill climber is the new suspension. While the SuperVan and SuperTruck used a double A-arm and single strut outboard arrangement, an inboard design was conceived for the Mach-E with two rocker arms to two different springs and the addition of a third damper in the middle of the chassis at both front and rear in a bid to best control the aero platform. The latest tech was also used, in details such as 3D

RIGHT Packed crowds watch the Super Mustang Mach-E get on its way 'to the clouds' on race day

RIGHT Romain Dumas picked up the Open Class spoils but Ford may yet decide to come back to tackle the full course next year

BELOW The 2025 Pikes Peak International Hill Climb may have been shortened but the startline is as daunting as ever

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printing the titanium uprights.

"We were pushing the limits of compromising ride compliance versus how much to support the load of the aerodynamics [with SuperTruck]," says Burns of the suspension. "With the new vehicle, we changed to an inboard suspension with a third element. This lets us run softer springs on the corners themselves, so we can be more compliant for the bumpy section at the top versus supporting the aero loads that we'll see on the lower section."

Return ticket

Aside from fine-tuning the chassis setup, working on correlation between the CFD modelling and the simulator work undertaken at Ford's facility in Concord, North Carolina, the car didn't have any major issues out of the box from initial testing right through to when it hit the ground in early May. But the fruits of Ford's efforts were sadly not borne in the event.

While the record books will show that the Mach-E finished second overall and claimed 'Open Class' victory in June's 103rd running of the Pikes Peak International Hill Climb in the hands of Dumas, the real picture is that the route was much shortened due to wind and debris causing issues on the upper end of the course.

This was precisely where the Mach-E was set to gain most in its victory quest as an electric machine with its improved chassis concept, compared to this year's overall winner Simone Faggioli driving a V6-powered Nova Proto NP01 prototype. As such Burns clearly feels the project has unfinished business.

"Personally, I would love to take it back to Pikes Peak again," he says. "It's frustrating because we were only able to show what the speed is like at the lower section. Where an EV demonstrator comes into its own is that middle section where it's straight, brake and hard acceleration through the hairpins. Then to show and validate the suspension we just designed and developed, to work on the compliance of the upper section with how bumpy it is. So it was a bummer that we couldn't run the whole mountain just to prove the capabilities of the vehicle. I would love to go back with this one and show what we could do."

The ultimate say on the return, or not, of the Mach-E will no doubt be commercially led. But the sentiments of Ford Performance Global Director Mark Rushbrook, even within the wide array of motor sport programmes in which Ford is involved, offer further hope of a return.

"We're continuing to push the boundaries of what's possible with electric vehicles," he says. "This Super Mustang Mach-E demonstrator represents the next stage in our electrification journey — lighter, leaner, just as powerful, and more capable in high-altitude competition. Racing is our test bed. Every data point we gather on the mountain helps us build better electric vehicles for our customers whether it's maximizing power delivery, improving regen strategies, or managing heat in extreme elevation changes. What we learn here goes straight into future production."

It's far from inconceivable that Ford Performance, STARD and the Super Mustang Mach-E will be back on the Colorado mountain next June, chasing the overall record time of 7m 57.148s, set by Ford driver Dumas himself with the Volkswagen Motorsport IDR in 2018.

Maybe every Race to the Clouds has a silver lining... RT

THE HEAT OF THE MOMENT

Chris Pickering speaks to Conflux founder Michael Fuller about the company's innovative approach to producing state-of-the-art heat exchangers

LIKE it or not, engineers are constantly constrained by the limitations of the materials and the techniques they use. It's never possible to escape this completely, but with modern methods like additive manufacturing, it is possible to break the rules that have existed in the past, opening up new design freedoms and pushing the boundaries of conventional wisdom.

That's the philosophy behind Conflux, a high-performance heat exchanger specialist set up by former F1, World Rally and sports car engineer Michael Fuller.

Fuller's experience of 3D printing techniques stretches back to his F1 days, when he first encountered the concept used for wind tunnel models. However, it was the use of additive manufacturing to produce functional brake ducts a few years later that really caught his eye.

BELOW Conflux uses 3D printing to produce technology such as this ultra lightweight water-charge air cooler for the Donkervoort P24 RS supercar

"Typically, the design freeze used to be eight to 10 weeks before a particular target race. You had carbon fibre components all in a jig bonded assembly, plus all the jig pieces and all the mould tools," he recalls.

"You might be talking about 60 or 70 moulds per corner, so the design freeze needs to happen quite a long way in advance. Whereas the 3D printing technology allowed us to stay in the wind tunnel for another six or seven weeks and then go through the manufacturing process in seven days. That was a huge aero benefit – getting loads more wind tunnel runs (when you could still do that in F1). And that was when I realised this technology has some really interesting implications – not just around the geometries that you can make as a designer, but also the lead times and the business model implications."

Fuller founded Conflux in 2015. The firm uses laser powder bed fusion (LPBF) to produce heat exchangers with complex internal geometries that would be impossible to manufacture with traditional methods. Designed specifically to harness the freedoms of additive manufacturing, they're said to offer comparable performance to F1-grade microtube heat exchangers but without the price tag.

"We knew we had to target the best in class if we were coming in with a new technology," he comments. "Microtubes perform at a very high level of heat transfer, but the cost asymptote for that sort of technology is high, and they're also somewhat limited in terms of form factor.

> *"3D printing technology allowed us to go through the manufacturing process in seven days"*

"Our technology is largely decoupled from tooling implications, so we can produce significantly different variants on the same production line; we have more geometric freedom to adapt to specific requirements; and we can produce these heat exchangers at a significantly lower cost than microtubes, with the costs coming down further over time."

Conflux's approach can be applied to just about any heat exchanger, but its most common applications in motorsport are intercoolers, oil coolers and cold plates for electronics.

The LPBF process uses high-power lasers to melt specific areas in a bed of metal powder. After each layer is melted, the build platform lowers, allowing a new layer of powder to be added. The geometry of the part is built up layer by layer, with finer resolution than most additive processes, while the finished part is said to offer similar strength to ▶

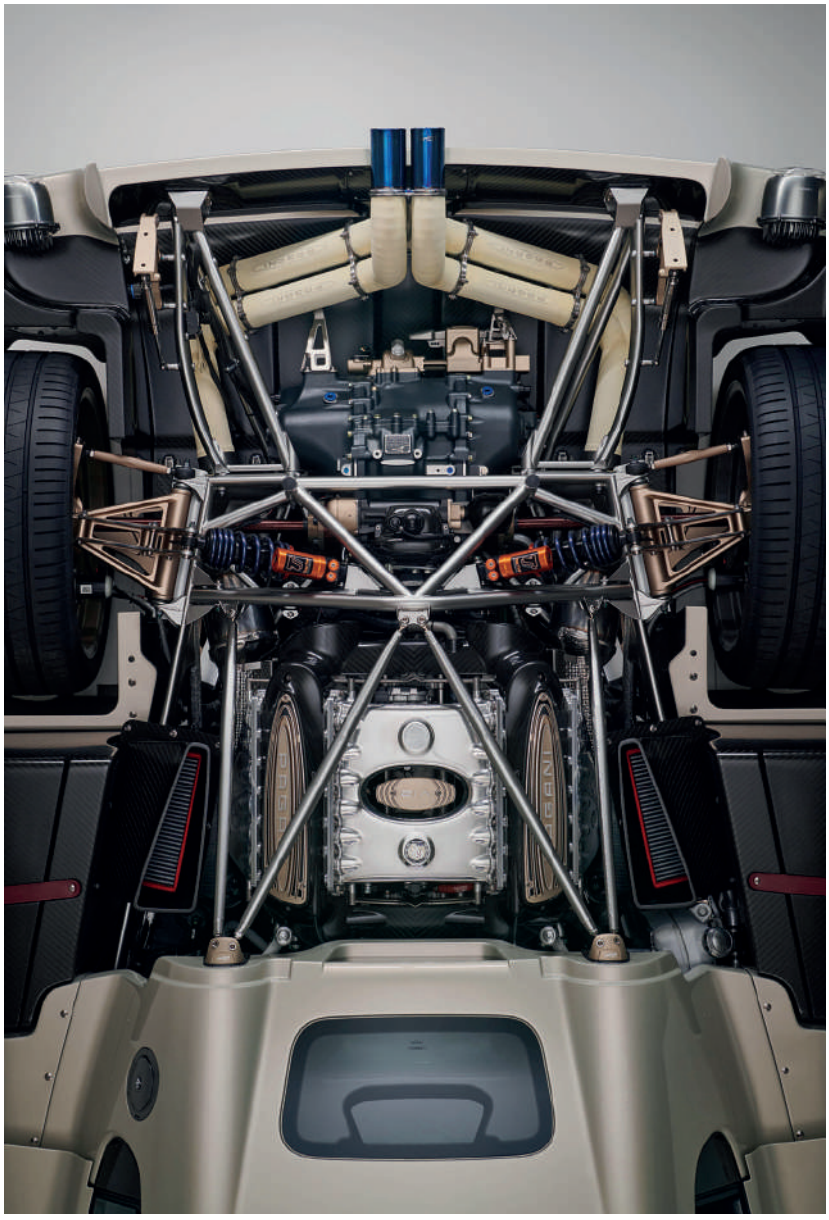
materials processed with traditional methods.

Conflux uses three different materials. There's an aluminium alloy (AlSi10Mg), a stainless steel (SS316L) and a nickel-copper alloy (Monel K-500). Aluminium is a popular choice for motorsport applications as it blends high thermal conductivity with light weight, plus there are well-established treatments to provide good oxidation and corrosion resistance. Stainless steel is an interesting option as it provides good compatibility with hydrogen, which a growing number of motorsport manufacturers are starting to contemplate.

Additive manufacturing brings new design options. For instance, the three-dimensional surface geometry inside the part can be optimised along the path of the fluid flow. This means it's possible to design the geometry with a different profile at the inlet to the outlet, optimising each stage for the fluid's changing properties as it cools.

On the other hand, additive manufacturing does present its own limitations. It tends to work best for small format heat exchangers, for instance. Conflux does produce water radiators for other industries, but it's not an application that the LPBF process typically lends itself to in motorsport, where low energy ram air installations require a large frontal area with a very thin core to minimise weight. Here, the brazed fin and tube techniques can apply thinner wall thicknesses, potentially delivering a weight benefit over an additive process. For large parts, the inherent cost benefits of additive manufacturing can be harder to achieve too. Elsewhere, however, Fuller believes that

RIGHT Conflux Technology has joined forces with Pagani to increase transmission heat rejection on its latest hypercar, the Pagani Utopia



BELOW The Pagani V12 is a bespoke 6-litre twin-turbo engine by Mercedes-AMG paired with a custom Xtrac seven-speed transmission

BELOW Conflux's custom-built cartridge heat exchanger for the Pagani Utopia has achieved a 30% increase in heat rejection compared to the previous solution

LBPF delivers some compelling advantages.

"We're bringing F1-level tech to mid-level motorsport. And because our technology doesn't rely on specific tooling, the products we can offer at this price point still match or sometimes exceed the performance of existing alternatives," he notes.

Microtube heat exchangers are typically the preserve of teams in Formula 1 and the top echelons of the World Endurance Championship. Fuller says Conflux's additive technology can be applied to any application ▶

where the sales volumes range from hundreds to low thousands, including potentially spec series like F2 and F3, as well as GT racing and road-going hypercars. Conflux already has a relationship with Italian supercar manufacturer Pagani, having collaborated on the design of a transmission cooler for the new Utopia.

Manual design

The freedom to craft complex geometry in three dimensions might sound like a recipe for computer-driven design tools producing weird and wonderful shapes, but the reality is that the human designer is still very much in control.

"I get asked a lot, 'what generative AI tools do you use?' Or 'what software do you use to come up with the concepts?' But, crazy as it might sound, we do a lot of it by hand, starting off with basic calculations around the heat transfer that's required," explains Fuller.

"In any form of manufacturing, you need to understand the sensitivities around the geometry and how that fits in with the processes that you use. Ironically, the geometries that can be made with the smallest feature distances, the cleanest walls and the highest resolution are generally the simplest."

As with any type of 3D printing, complex geometries like steep overhangs require support structures. These can be removed after the LPBF process if they are external, but they must be built into a functional part of the cooler if they're internal.

> *"Most people aren't looking for an unusual form factor, they just want performance"*

"This is really where a lot of our design expertise comes in, but the benefits of using additive manufacturing generally come inside the core rather than in the form factor," says Fuller. "When I started the company, I imagined that everyone would want to have these strange morph topologies for a super tight, complex packaging. As it turns out, most people aren't looking for an unusual form factor, they just want performance."

The LPBF procedure is just one step in a wider manufacturing process, Fuller points out. He estimates that less than half of the production costs come from the additive manufacturing. One of the other challenges is cleaning the residual powder that remains in the part. For this, Conflux has developed a multi-stage proprietary cleaning process, which has involved designing and developing its own machinery to achieve the desired levels of cleanliness.

"A lot of our R&D efforts are focused on reducing

BELOW Conflux has recently announced a new UK hub to serve its growing European market alongside its manufacturing base in Australia (pictured)

the costs of the steps that come after the additive manufacturing has finished," he notes.

Conflux has built up a library of heat exchanger geometries that were developed and simulated manually, but this has now been used as the training data for a proprietary machine learning tool. This speeds up the potentially time-consuming process of sizing a heat exchanger for a particular set of boundary conditions and targets.

Conflux carries out multi-physics modelling using off-the-shelf tools from Ansys. When it comes to the 3D printing process, the company uses industry standard software like Materialised Magics, but it has also developed a number of proprietary tools to aid the process.

"One of the challenges to overcome is data management: because a complete heat exchanger is made with multiple manufacturing techniques, you never need to have a full volumetric CAD model of it for production. But we do need to have a complete digital representation of the end product. When you're talking about potentially 200,000 fins and 400,000 connections between a fin and a wall, you'd end up with an absolutely colossal file size if you were to do it conventionally, but we've figured out a way to do what we need to do without that having to exist as one file."

New challenges

The future looks set to pose some interesting questions for heat exchangers. Hybrid and battery electric powertrains produce less heat than internal combustion engines, but they behave optimally in a very small window, which places every bit as much emphasis on thermal management, notes Fuller.

"The strategies around energy management can be really thermally limited, and this is where we see a lot of interest and a lot of activity in our customers. You have different cell and battery architectures, which have different thermal requirements," he comments. "The cells expand and contract over their charge and discharge cycles, so you have a quasi-static device with force and displacement. Managing the thermal flows of a non-linear, non-static structure is really interesting and it's a very different challenge to a radiator on a combustion engine."

Thermal management has evolved from systems where the sole function is cooling to complex networks that potentially handle heating at some parts of the duty cycle. This might be integrated with the thermal management for the stator or the inverter, leading to multiple fluid circuits that all need to interact with one another.

The thermal management challenges on a racing car extend well beyond the powertrain. There's an increasing range of electronics on modern vehicles that requires cooling.

"These days, there's a lot more to the electrical architecture on a car than one ECU and a CAN bus. If you think about the AI chip race that's underway at the moment, Moore's law is being exceeded. They're producing far more heat per unit area because they're doing so many more calculations. And that really is a thermal limitation."

ABOVE Conflux Business Development Lead Daniel France shows off the water-charge air cooler for the Donkervoort P24 RS supercar

The heat exchangers themselves are changing too. Fuller points to work that Conflux has done in collaboration with one of its customers to broaden out the role of these devices.

"We've got some fascinating technology we're working on with customers where the heat exchanger is not just used for heat exchange," he comments. "Bringing multiple functions together to consolidate the bill of materials – not just in a part count perspective, but also bringing new functionality, enabled by the geometries that we can produce. It's a fascinating area to be working in."

With additive manufacturing techniques continuing to evolve, there are still gains to be made. Each time that happens, the goalposts reposition themselves – redefining what it's possible to achieve. RT

BELOW Conflux uses additive manufacturing to produce tailor-made solutions for its heat exchangers

DPPI/WEC/FIA

FLEXIBLE FRIENDS?

Sergio Rinland considers the flexibility of the #50 Ferrari's wing at the end of the Le Mans 24 Hours and the inflexibility of the stewards

THE 2025 Le Mans 24 Hours did spring the odd pleasant surprise, such as the spectacular pole position claimed by the Jota Cadillac LMDh. It demonstrated that the platform equivalency between LMH and LMDh is, at least in qualifying, doing its job.

However, once the race began, it became clear that the LMH cars had the upper hand, with Ferrari leading the way. Echoing the results of 2023 and 2024, Ferrari clearly emerged as the dominant force. Perhaps the Balance of Performance isn't quite so balanced after all?

One situation that remains unclear (and, in my view, unjust) was the disqualification of the No. 50 Ferrari, after finishing fourth.

According to the officials, the car failed post-race technical scrutineering due to excessive flexibility in the rear wing. But of course it did: the central mounting failed. Naturally, that made the wing more flexible.

The stewards also cited a potential safety risk, suggesting the rear wing could have detached. But it didn't...

During the final pit stop, an engineer noticed that one of the four fixing bolts was missing, but judged that the remaining three would do the job for a single stint. The decision was based on the reality that replacing the bolt would cost valuable time at such a critical stage in the race. I'm sure that the judgment would have been different had the issue been detected earlier in the race.

ABOVE A failing wing wouldn't have been much fun in the corners…

As it turned out, the No. 50 Ferrari lost the other three bolts during that last stint. Officials argued that this created a straight-line speed advantage (something akin to an always-on Formula 1 DRS), which may be true, as it recorded its highest top speed of the race during that period.

But what about cornering? A sudden loss of rear downforce is hardly a welcome feature for a Le Mans driver, especially after 23 hours of relentless focus and fatigue. The car was likely a handful through the Porsche Curves, Tertre Rouge, and elsewhere.

In my view, the rear wing failure offered no real advantage. If anything, it made the car harder to drive. And let's not forget, it didn't win the race; it merely finished fourth.

Over the past 30 years of the 24 Hours of Le Mans, there have been eight notable disqualifications (not including Ferrari No. 50). None of them stirred controversy, because the infringements were clear cut.

I experienced one of those "unfair" disqualifications myself after winning the GT1 category at the Nürburgring 6 Hours in 2006 with the Aston Martin DBR9. We were unable to provide the mandatory one litre of fuel for analysis, even after scraping every wrinkle of the tank with a spoon! As frustrating as it was, the rule was clear. We should have added another litre at the final stop. If there had been a fuel leak, it would have been a different argument altogether.

Having reviewed the official reports and put my 'competitor hat' on, I believe the disqualification of Ferrari No. 50 was wrong. This was a typical mechanical failure that could have resulted in an accident, but didn't, and certainly did not give them a meaningful advantage.

I know that, as Roger Whittaker once sang, "'if' is for children"... but still, what if Lando Norris had completed the final three laps of the Canadian Grand Prix without a front wing, finishing somewhere mid-field? Would the scrutineers have disqualified him simply because they couldn't check the front wing's flexibility? RT

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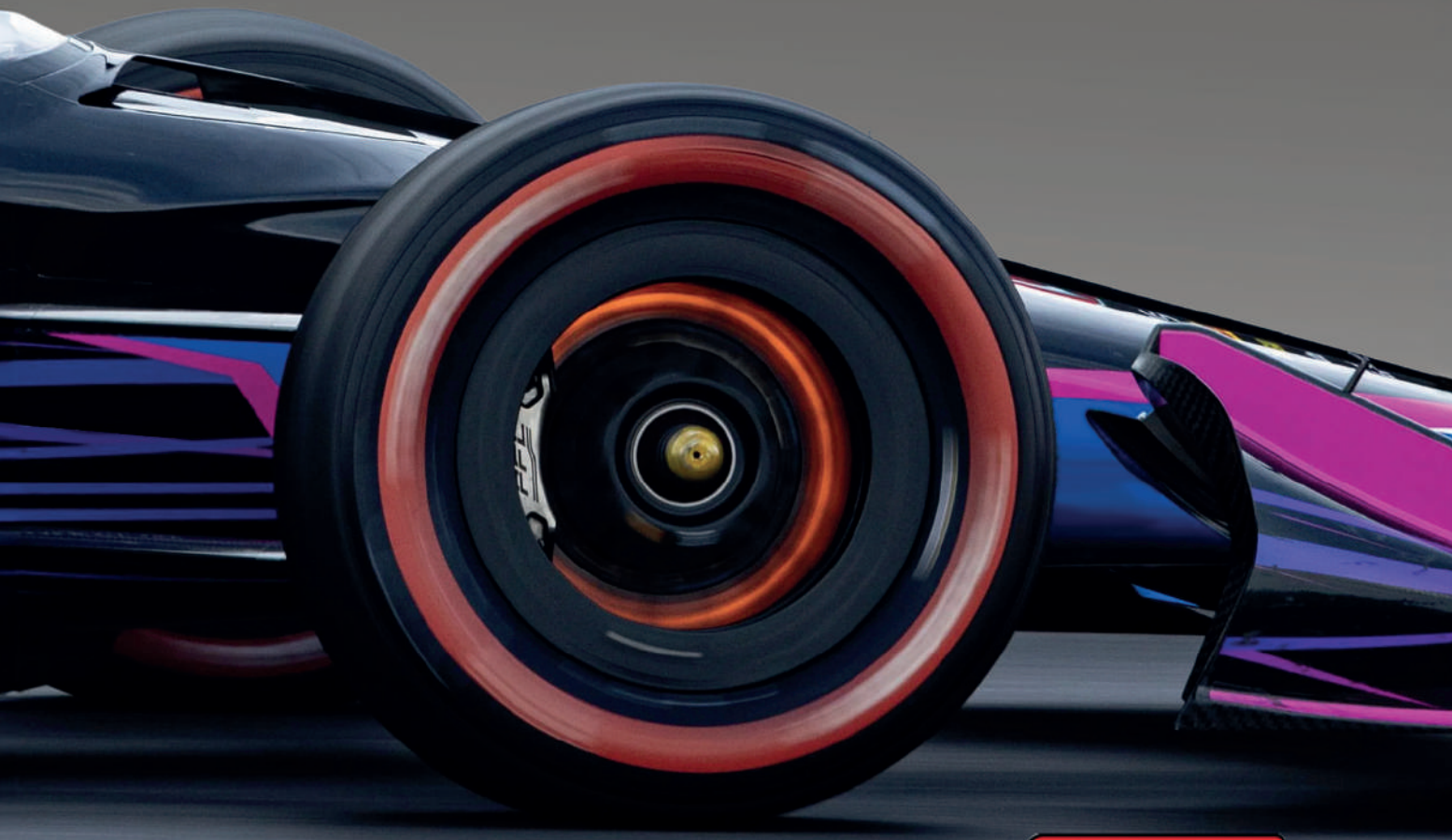

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